Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLII. No. 9. NEW YORK, SATURDAY, FEBRUARY 28, 1903. ISSUED WEEKLY

ELECTRICAL REVIEW

13 to 21 Park Row NEW YORK

BY THE

ELECTRICAL REVIEW PUBLISHING COMPANY

CHARLES W. PRICE . . . . PRESIDENT and EDITOR
STEPHEN H. GODDARD . SECRETARY and MANAGER
RUSSELL HOWLAND . GENERAL REPRESENTATIVE
WM. HAND BROWNE, JR. . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

WESTERN OFFICE — 40 Dearborn Street, Chicago, Ill. CHARLES FFRENCH, Manager.

EUROPEAN OFFICE — 42 Old Broad Street, London, E. C. HENRY W. HALL, Manager.

TELEPHONE CALL (private branch exchange connecting all departments) — "21 Cortlandt."

REGISTERED CABLE ADDRESS — "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10
Copies supplied for only one year back, each . . 25

TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

INSTITUTE DEVELOPMENT.

The work of the local branches of the American Institute of Electrical Engineers is meeting with a gratifying success. A very successful meeting has been held at Boston, and the week previous the Pittsburg branch not only found time to hear the papers presented recently in New York, but received some original contributions. These meetings can not fail to interest young engineers in Institute matters, and will in this way aid in bringing the Institute to the position it should occupy.

The Transactions.

It was announced last fall that the work done by the Institute had increased so largely that it would be necessary to issue the transactions in two volumes. If these transactions include the reports of all the local branches—as they should—it looks now as though each of these volumes will be found too bulky for convenient handling.

THE EXPIRATION OF THE BRUSH STORAGE BATTERY PATENT—EFFECT ON THE STORAGE BATTERY INDUSTRY.

The third day of March next marks the expiration of the Brush patent on storage battery electrodes, and the last barrier in the way of the general manufacture of storage batteries will then be removed.

The Brush Claims.

This patent covers completely the art of making plates by mechanically applying the active material as a paste, powder or in any other form, the claim reading "any mechanically applied material, either active or to become active." This claim is so broad that to some engineers it is doubtful whether the Edison battery could have been marketed while this patent remained in force.

Brush Patent Sustained by the Courts.

This is one of the most remarkable patents in the history of the electrical art and has withstood repeated assaults in the Federal courts. Enormous sums of money have been spent in litigation to have the patent declared invalid, but it has in every instance come forth victorious.

The Line of Argument.

Generally the line of argument has been that the expiration of the British and Italian patents—particularly the latter—had made the American patent public property. This condition, together with the fact that Faure was known to have made pasted electrodes as far back as 1880, has made the repeated sustaining of this patent within recent years incomprehensible to the electrical profession generally, which has not understood all the circumstances. In 1881 Brush applied for four patents covering applied active materials, and envelopes which were wrapped around the plates to hold the material in place, when, after long use, particles began to drop off.

One Patent Held Up.

Three of these patents were granted at once and expired five years ago. The fourth was held up because of an interference suit with Faure, who about that time also applied for patents on the same type of electrodes. This suit, which was won by Brush, continued for nearly five years, with the result that the patent was not *issued* until March 3, 1886. This explains the inability of contestors to shake the validity of the patent by citing instances of pasted plates being made in 1880 and 1881—five or six years before the patent was actually issued.

Effect of the Expiration.

As to the effect in this country that will follow the expiration of this patent, opinions are divided. It is, however, certain that all who look for any substantial reduction in the price of storage battery equipments will be disappointed. That there may be some decrease is, of course, to be expected, but the present cost of materials and manufacture precludes the possibility of any great reduction.

Small Factories Not Probable.

Another erroneous idea that seems to prevail is that anybody who is so inclined can go into the business of making storage batteries with but little capital, and no equipment further than a lead-melting kettle, a grid mould, a mortar and pestle, and a spatula. The processes of manufacture in turning out pasted electrodes are as complicated and delicate as those required in the production of Planté plates. Many of Planté's processes have been public property for several years, but the number of factories making Planté batteries has not increased. The pasted plate requires a forming process in many instances as long as that required by the autogenous Planté processes. Even if the active material is completely oxidized when applied.

Effect on Manufacturers of Planté Plates.

It is highly probable that present manufacturers of Planté plates may discard this process and use that of Brush in the production of their negative electrodes.

It has been settled beyond a doubt in Germany—where the storage battery has attained its highest development—that the pasted plate is by far the cheaper and better for the negative, though there are successful Planté negatives now being made in this country and England.

Recent Tests of Storage Batteries.

Up to within the past year it has generally been believed among storage battery experts that the Planté positive and pasted negative made the most durable and efficient cell. The exhaustive and strenuous tests conducted last year by the French Admiralty have shown that the cells with both electrodes pasted are the more durable. In these tests over two hundred cells were tested up to the point of disability or destruction. The last five to give way were about equally good, and of these, four had both electrodes pasted and one had pasted negative plates, the positives being Planté formed. These tests have materially changed the sentiment of battery manufacturers, and it is probable that pasted cells in large sizes for power purposes will appear in this country after the expiration of the Brush patent.

Benefit to the Automobile Industry.

The electric motor-car manufacturers will profit more than anybody else by the new order of things. Lighter and better batteries for motor cars will appear, and the highly developed products of the European makers can be imported. In this way the prices can be kept reasonable and the performance of electric motor cars greatly improved, with a resulting increase in their popularity and an augmented business for manufacturers, both of the machines and the batteries.

Power Station Batteries.

As for the power station batteries, this business will still be in the hands of a few makers, for the reason that regulation and storage can only be successfully accomplished by the use of automatic boosters, and these are covered by a multitude of patents, which are distributed among three battery manufacturing companies. This will confine the power work to these owners.

General Summary.

To sum up, the result of the expiration of the Brush patent will be to improve and extend the use of power batteries, though not markedly, and to increase greatly the quantity and quality of the cells for motor-car work.

ELECTRIC RAILWAYS IN ENGLAND.

The electric motor has at last come into its own for traction work in England, and from the reports of its successes, its friends may look forward with confidence to its general application in the years to come.

Conditions at Present.

A recent issue of the London *Electrician* gives some statistics of British railway systems which show that at the beginning of last year there were eighty-five electric tramways then in operation. At the beginning of this year there were one hundred and thirteen, an increase of nearly thirty-three per cent. This figure, however, does not include a number of lines which have been added to systems already existing.

At this time there are fewer lines in course of construction in England than was the case last year, but this is attributed not to any decrease in the activity of traction industry, but to the rapidity with which the work is now pushed to completion.

Systems in Use.

The overhead trolley system naturally has found the widest application. There is but one instance mentioned where the Siemens bow collector has been adopted, this being a line at Sheerness, now nearly completed. At Bournemouth there is a modern electric conduit system in operation, differing but little from those now in operation in this country. In the British system the slot is arranged at the side of the track, and not in the centre, as is customary here. This arrangement was made as it was believed to offer less obstruction to other traffic on the road, but it makes the construction more complicated, and at switches and terminals it is found necessary to switch the slot to the centre of the track. The conduit in this installation is used only in the city, the overhead trolley taking its place for the outlying districts. At Wolverhampton there is a surface contact system which is running satisfactorily.

Municipal Systems.

Statistics are also given for two municipal systems—that at Leeds and that at Hull. These tables give figures of the operating cost of electric, steam and horse systems. It is interesting to note that the cost per car-mile for the steam and horse cars is given as about nineteen cents, while that for the electric is twelve and one-half cents. These figures do not include interest and depreciation.

Operation of Trunk Lines.

The use of electricity for operating trunk lines has attracted not a little attention in England, and, according to the *British Trade Review*, has had some effect on financial conditions of railway securities. The Lancashire & Yorkshire road has adopted electric traction on part of its system, and the Northeastern company has now a section of its road completed; but it is stated that it will not be put into service until a second section of the road is also ready. The same authority states that the time is not far distant when the great trunk lines will be worked by electric locomotives, and passengers and freight will be conveyed at greater speed and possibly cheaper rates. The change from steam to electricity as a motive power would mean a vast amount of work, both in engines and track alterations, and the railway companies will be obliged to face large capital expenditure. This outlook has had some effect on railway stocks, and, in some cases, these are now quoted at figures considerably less than was the case a few years ago.

GAS TURBINES.

A development of the steam turbine which may be looked forward to is the adaptation of this to the use of gas. This will not only do away with the boiler plant, but will increase the available range of temperature and thereby the efficiency very greatly. As is well known, the reciprocating gas engine, in spite of the enormous waste of heat through the water-jackets, has an efficiency equal, if not better than that of the best steam engine. There seems to be no reason why this loss could not be largely avoided in a gas turbine. This arises from the necessity of keeping the cylinder temperature comparatively low. The turbine, having no sliding surfaces exposed to hot gases, can operate at a much higher temperature.

ACCUMULATOR TRACTION ON RAILROADS.

On another page of this issue, Signor Enrico Bignami gives a description of two successful applications of storage batteries to railway work. These two roads are located in the northern part of Italy, one connecting Bologna and San Felice, and the other Bologna and Modena. The first is twenty-six miles in length, and the latter twenty-three, each line having a grade of five per cent.

Reason for Adopting Storage Batteries.

The traffic on these roads was too light to warrant the expense of using an alternating system with three rails. The Bologna-San Felice road was put in operation in May, 1901, and the other in December of the same year. Both roads have therefore been in operation for over a year, apparently with much success.

Results of Tests.

Figures of tests made on these roads are given by Signor Bignami, which show a surprisingly small consumption of energy per ton mile. The costs of materials and labor are low, so that the total expense of operation, exclusive of the cost of maintaining the road-bed, is found to be 22.8 cents per train mile for an electric train, and 31.8 cents for a steam train. The electric train weighs about fifty-two tons.

Experience with the Batteries.

The life of the batteries is given as 6,800 miles for the positive plates, the life for the negative plates being double this. The weight of the plates is 14,000 pounds, costing about six cents a pound. This is a very low figure, and, taken in connection with the low consumption of energy, possibly accounts for the success of the roads.

A new feature in these equipments is the method of connecting the batteries. The cells are grouped into twelve cases, and leads from each case are run to a switchboard placed in the baggage compartment of the train. Here it is possible, in case of trouble with any one battery set, to locate the faulty group and cut it out without interfering with the operation of the train.

Probable Reasons for This Successful Operation.

The reported success of these two roads will probably come as a surprise to many, for, as far as we are aware, there is in this country no railroad of any importance operating with storage batteries. It is true there is a short crosstown line on Thirty-fourth street, New York city, where local conditions necessitated the use of accumulators. We believe there is also a small road in Canada; but since the abandoning of accumulators on the Chicago & Englewood road, there has been no serious attempt to use them for railway work in this country. Undoubtedly, the low cost of batteries, the low value for the traction coefficient, and the easy working of the batteries on these Italian roads, may be considered as the reasons for this successful application.

Recalling the history of alternating currents as applied to traction work, both in this country and abroad, one can not help asking whether we have heard the last of accumulator traction in this country and how slight an improvement is necessary to enable accumulators to be used successfully in this work.

ON ELECTRONS.[1]

(Concluded.)

BY SIR OLIVER LODGE.

SUMMARY OF OTHER CONSEQUENCES OF ELECTRON THEORY.

RADIO-ACTIVITY.

If many atoms of a substance have electrons attached to them, and if these are performing orbital revolutions, it is natural to ask how, then, it can be that substances are not constantly emitting waves and radiating away their energy. Fortunately, owing to the brilliant researches of Becquerel, Curie and others, certain substances have been found in which the radiation intensity reaches a very perceptible magnitude; and it appears that this radiation may be of several kinds: (1) Of waves or pulses analogous to Rœntgen radiation, probably; (2) of rays analogous to Lenard or cathode rays, consisting of electrons and ions bodily shot off, certainly; (3) of detached portions of the substance itself not charged with electricity, but emanating like an odor, and possessing, like the rest of the substance, an intrinsic radiating power, and capable of attaching itself to other materials in the neighborhood, so that they, too, acquire temporary radiating power.[1]

The substances which possess any noteworthy amount of this radiating power are substances of very high atomic weight, and their emitting power would appear to be probably due to an internal commotion and collision between the atoms, of sufficient violence to detach, and, as it were, evaporate every now and then some of the smaller particles; and also by the shock of the collisions to generate some feeble Rœntgen rays.

It is easy to grant that whenever there are actual collisions of sufficient suddenness some radiation of this kind must be emitted; but we can not help asking, why does not the quiet orbital revolution of electrons round atoms, in a substance not in a high state of thermal disturbance and not possessing specially massive atoms, why does not this also give rise to a perceptible amount of radiation and loss of energy? But I doubt if such answer is wanted, save that radiation of a low temperature order is, as a matter of fact, always going on from all substances; that energy is conserved and constancy of temperature persists merely because loss is equal to gain, because absorption compensates radiation, not because radiation ceases. The whole subject of radio-activity is a large one, upon which I do not propose to enter here and now. Suffice it to realize that any difficulty of explanation in connection with it is not the fact itself, but rather why it is not more notorious.

However, so far the most striking and interesting excessive photographic and electric radio-activity of certain rare substances is concerned, it has already been hinted that the greater part of that does not consist so much in the emission of radiation proper—whether in the form of pulses of X-rays or any other form—as in the flinging off of particles, negatively charged particles or electrons as a rule, but also, sometimes, according to Mr. R. J. Strutt, of positive ions also.

The whole subject, together with the allied one of the loss of charge from hot

[1] Abstract of Part VII of a paper read before the British Institution of Electrical Engineers. Parts I to V have been abstracted.

[1] See, for instance, papers by the original discoverer, M. Henri Becquerel, in *Comptes Rendus*, 1896 and 1897; see also Rutherford, *Phil. Mag*, January, 1899 and 1900, with quantitative determinations concerning it. Also in *Phil. Mag.*, July and November, 1902. Other references are M. and Mme. Curie, *Comptes Rendus*, November, 1899; Hon. R. J. Strutt, *Phil. Trans.*, A, 1901, vol. cxcvi, p. 525; Sir W. Crookes, *Proc. Roy. Soc.*, vol. lxvi, p. 409, (1900), vol. lxix, p. 413 (1902), also "Electrical Evaporation," 1891, *Proc. Roy. Soc.*, vol. l, p. 88; and many other workers.

bodies,[1] first discovered by Dr. Guthrie long ago (see *Phil. Mag.* [4], xlvi., p. 273), is one that demands special attention and treatment, for which there is no opportunity now.

SOLAR CORONA, COMETS' TAILS, MAGNETIC STORMS AND AURORÆ.

The theory of auroræ has recently been elaborated by Arrhenius, but the whole doctrine of emanations from the sun, and of repulsion of small particles both by his light and by his probable electrification, is a matter that has been familiar to me for several years, through conversation with Fitzgerald and others. The earth is, in fact, a target exposed to cathode rays, or rather to electrons emitted by a hot body—*viz.*, the sun. The gradual accumulation of negative electricity by the earth is a natural consequence of this electron bombardment, and the fact that the torrent of particles constitutes an electric current of fair strength gives an easy explanation of one class of magnetic storms; which have been long known, by the method of concomitant variations, to be connected with sunspots and auroræ. The electric nuclei would also serve as centres for condensation of atmospheric vapor at high altitudes and so be liable to affect rainfall.

Nevertheless, it is true that these theories have been well elaborated of late by Arrhenius, and his explanation of the aurora by means of the catching and guiding of rapidly moving electrons by the earth's magnetic lines of force, so as to deflect them from the tropics and conduct them in long spirals along the lines to the poles, there to reproduce the phenomena of the vacuum tube in the rarefied upper regions of the atmosphere, is particularly definite and pleasing. Some of the other astronomical suggestions he has made are likewise of considerable interest.

VALIDITY OF OLD VIEWS.

Now that the doctrine of electricity (at least of negative electricity) as located in small charges or charged bodies is definitely accepted, and now that the current can be treated as the locomotion of actual electricity, it may seem as if some doubt were thrown upon the doctrine—which, a little time ago, was spoken of as a "modern view"—that the energy of an electric current resides in the space round a conductor. There is no inconsistency, however. The whole of the fields of an electron are outside itself; it is in its fields that its energy resides, and it is in the space around it that energy is conveyed when it moves; for the ether in that space is subject to the coexistence of an electric and a magnetic field. So, also, its inertia resides in space round it, for it is accounted for by the electromotive force set up when its magnetic field changes; that is, when its motion is accelerated.

In dealing with the inertia of matter, it is commonly supposed that the inertia resides in the matter itself, whereas electrical inertia is known to reside in the space around the nucleus. The appearance of inconsistency vanishes when we come to calculate and realize how extremely local and concentrated the intense part of the field of an electron is. The magnetic field falls off inversely as the square of the distance from the moving nucleus, and hence, at a distance far less than a millimetre, less even than the size of an atom, it is quite inappreciable. The whole magnetic field on which its inertia depends lies practically very close to the electron itself; it is just its extremely small size that enables this concentration to be possible, and even in a closely packed mercury atom there is practically no encroachment of the field of one electron on its neighbors. They are all independent, each with its own inertia, almost isolated from the others; for, if it were not so, the mass of a body in close chemical combination would not continue constant, but would diminish.

The assertion that an electric current is a transfer of electrons, and that the energy of a current travels in the space surrounding the moving electricity, are statements not inconsistent with each other. Nor are the statements inconsistent that the mass of a body resides in its atoms, and that inertia or momentum is a property due to the self-inductive influence of the electromagnetic field surrounding a moving electric nucleus. So also with the way in which a current is propelled. The pace of progression of electrons through a solid may be considerable, see next section, but it is very far below the pace at which a telegraphic signal travels along a wire. They must be propelled by a lateral action, transmitted through the ether with the speed of light appropriate to the surrounding insulator, by some arrangement which "Modern Views" symbolized in the form of cog-wheels; they can not be impelled by end thrust. The electric current is a more material entity, or has a more nearly material aspect, than was thought probable a little while since; but all that was taught about its mode of propulsion and the diffusion of the propelling force from outside to inside through successive layers, as if it were of the wire, all that was taught about the paths by which the energy travels and arrives at point after point of the wire, there to be dissipated as heat, remains true.

NUMBER OF IONS IN CONDUCTORS.

The immense number of electrons that are necessary to make up the mass of a piece of platinum, or of a lump of matter like the earth, can readily be estimated; so, also, it is easy to imagine that an enormous number must be traveling in order to give customary strengths of current such as can readily pass through a liquid.

CONCLUSION.

The subject is very far from exhausted, but I must not attempt to cover more ground. The most exciting part of the whole is the explanation of matter in terms of electricity, the view that electricity is, after all, the fundamental substance, and that what we have been accustomed to regard as an indivisible atom of matter is built up out of it; that all atoms—atoms of all sorts of substances—are built up of the same thing. In fact the theoretical and proximate achievement of what philosophers have always sought after, *viz.*, a unification of matter. And another surprising and suggestive result is that the spaces inside an atom are so enormous compared with the size of the electrical nuclei themselves which compose it; so that an atom is a complicated kind of astronomical system, like Saturn's ring, or perhaps more like a nebula, with no sun, but with a large number of equal bodies possessing inertia and subject to mutual electric attractive and repulsive forces of great magnitude, to replace gravitation. The radiation of a nebula may be due to shocks and collisions somewhat like the X-radiation from some atoms.

The disproportion between the size of an atom and the size of an electron is vastly greater than that between the sun and the earth. If an electron is depicted as a speck one-hundredth of an inch in diameter, like one of the full-stops on this page for instance, the space available for the few hundred or thousand of such constituent dots to disport themselves inside an atom is comparable to a hundred-foot cube; in other words, the atom on the same scale would be represented by a church 160 feet long, 80 feet broad, and 40 feet high, in which therefore the dots would be almost lost. And yet on the electric theory of matter they are all of the atom that there is; they "occupy" its

[1] See, for instance, Strutt on leakage from hot bodies *Phil. Mag.*, July, 1902; J. J. Thomson, ditto, *Phil. Mag.*, August, 1902.

volume in the sense of keeping other things out, as soldiers occupy a country; they are energetic and forceful though not bulky, and in their mutual relations they constitute what we call the atom of matter; they give it its inertia, they enable it to cling on to others which come within short range, and by excess or defect of one or more constituents they exhibit chemical properties and attach themselves with vigor to others in like or rather opposite case.

That such an atom, composed only of sparse dots, can move through the ether without resistance is not surprising. They have links of attachment with each other, but so long as the speed is steady they have no links of attachment with the ether; if they disturb it at all in steady motion it is probably only by the simplest irrotational class of disturbance which permits of no detection by any optical means.[1] Nor do they tend to drag it about. All known lines of mechanical force reach from atom to atom, they never terminate in ether; except indeed at an advancing wave front. At a wave front is to be found the reaction of a mechanical pressure of radiation whose other component rests on the source. This is an interesting but essentially non-statical case, and it leads away from our subject.

As to the nature of an electron regarded as an etheral phenomenon, it is too early days to express any opinion. At present it is not clear why positive electrons should cling so tenaciously to a group, while an outstanding negative electron should readily escape and travel free. Nor is the nature of gravitation yet understood. When the electron theory is complete to the second order, or some higher even order, of small quantities, it is hoped that the gravitative property also will fall into line and form part of the theory; at present it is an empirical fact which we observe without understanding; as has been our predicament not only since the days of Newton but for centuries before.

The positive electron has not, so far as I know, been as yet observed free. Some think it can not exist in a free state, that it is in fact the rest of the atom of matter from which a negative unit charge has been removed; or, to put it crudely—that "electricity" repels "electricity," and "matter" repels "matter," but that electricity and matter in combination form a neutral substance which is the atom of matter as we know it. Such a statement is an extraordinary and striking return to the views expressed by that great genius, Benjamin Franklin. On any hypothesis those views of his are of exceeding interest, and show once more the kind of prophetic insight which we have had occasion to notice in discoverers before and mentioned above. Undoubtedly we are at the present time nearer to the view of Benjamin Franklin than men have been at any intervening period between his time and ours.

The view that an atom is composed of an equal number of interleaved or interrevolving positive and negative electrons —to which it will have been observed I myself tentatively and provisionally incline—that view is not Franklin's; nor is it as yet anything but a guess. To make it more, work must be done upon the nature and properties of the positive charge; and the postive electron, if it exists, must be dragged experimentally to light.

Especially must the inner etheral meaning both of positive and negative charges be explained, whether on the notion of a right-and-left handed self-locked intrinsic wrench-strain in a Kelvin gyrostatically-stable ether, at present being elaborated by Larmor,[1] or on some hitherto unimagined plan. And this will entail a quantity of exploring mathematical work of the highest order.

[1] See *Phil. Trans.*, 1893, vol. clxxxiv, pp. 750-754; also vol. clxxxix, p. 166.

[1] See *Ether and Matter*, p. 326; or *Phil. Trans.*, 1894, pp. 810, 811, and 1897, pp. 209-212.

The Recovery of Tin from Scrap Plate.

The tinned iron is placed in a receptacle whose walls consist of a stronger electropositive metal than tin; *e. g.*, iron. According to a Swedish patent of B. A. Bergmann, of Nyfors, this receptacle is filled with caustic alkali and also contains a depolarizer, such as cupric oxide. An electric current results, while at the same time the tin is separated in the form of alkaline stannate. When the alkali lye is saturated with the alkaline stannate, a current of carbonic acid is immediately introduced into the solution. Thereby the tin separates in the form of stannic hydrate. This combination is treated with acid, and from the resultant solution the tin is finally obtained electrolytically in metallic form.—*Neueste Erfindungen und Erfahrungen.*

Electrical Resistance of Steel.

Values of the electrical resistance of steel have usually been measured on the soft qualities, such as those used for telegraph wire. It seemed desirable to M. H. LeChatlier to carry on a more systematic study of this important subject, and the results of his work are given in the following tables:

INFLUENCE OF CARBON.

Resistance.	Carbon.	Composition Manganese.	Silicon.
10	0.06	0.13	0.05
12.5	0.20	0.15	0.08
14	0.49	0.24	0.05
16	0.84	0.24	0.13
18	1.21	0.21	0.11
18.4	1.40	0.14	0.09
19	1.61	0.13	0.08

INFLUENCE OF SILICON.

Resistance.	Composition Carbon.	Silicon.
12.5	0.2	0.1
38.5	0.2	2.6
15.8	0.8	0.1
26.5	0.8	0.7
33.5	0.8	1.3
17.8	1.0	0.1
25.5	1.0	0.6
32.0	1.0	1.1

INFLUENCE OF MANGANESE.

Resistance.	Carbon.	Composition Manganese.	Silicon.
17.8	0.9	0.24	0.1
22	0.9	0.95	0.1
24.5	1.2	0.83	0.2
40	1.2	1.8	0.9
66 magnetic 80 non-magnetic	1	13	0.3

The specimens used in these tests were bars twenty centimetres long and one square centimetre in cross-section. They were heated for several hours at about 600 degrees centigrade. Their chemical composition was determined, and the constituents are also given. The figures of the resistance are in cubic microhm-centimetres. The results show that the electrical resistance grows decidedly with the percentage of carbon. Manganese also increases considerably the resistance of steels. Mixtures containing manganese can exist under two allotropic conditions which are unequally magnetic, and which possess different electrical resistances. Nickel increases the resistance, and also gives two varieties, unequally magnetic, and having different resistances. The increase of resistance in the case of nickel is extremely variable with the proportion of nickel. Chromium, tungsten and molybdenum increase the resistance of steel but slightly.

Mica in 1902.

An annual trade report for the mica industry in Great Britain in 1902 has been issued by Messrs. Tulloch & Company, of London. The year was an unsatisfactory one for importers, and not altogether prosperous for distributors and manufacturers. The increasing use of manufactured products of mica has lessened the demand for the best qualities and for large sheets. The outlook for this year is somewhat brighter, but a marked improvement is not expected.

Accumulator Locomotives on Two Lines of the Italian Central Railway in Emilia, Italy.

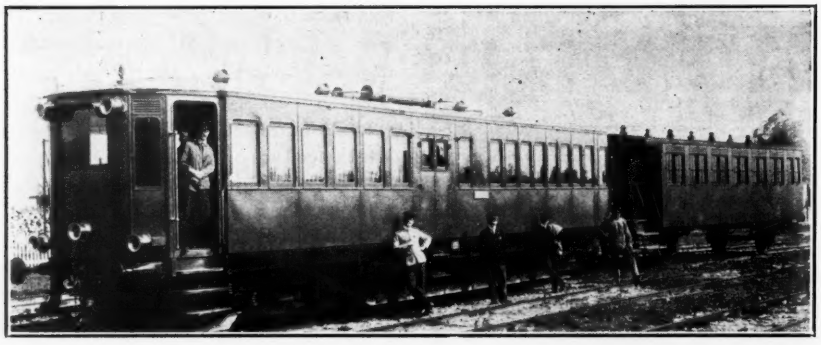
By Enrico Bignami.

AT THIS time, when every one is interested in traction problems, it is worth while to make public some observations and studies which are the outcome of encouraging tests with accumulator traction on the railway line between Bologna and San Felice and between Bologna and Modena. These investigations bring under consideration the problem of transforming to electricity many lines for reasons not heretofore accepted.

Italian railways can, with regard to their possible transformation to electrical operation, be divided into two main classes. To the first class are apportioned those on which the number of train kilometres is very great. Here the use of an alternating-current system with three rails is advisable. Long lines, or lines with light traffic, on which the ratio of the annual train kilometres to the length of the line does not, in spite of the increased number of trains and improvements, exceed a certain limit, belong to the second class. For lines of this class transformation to electric systems in vogue to-day can not be considered.

The necessity then arises of studying other systems for the solution of the problem, since lines of this class form the greater part—possibly eighty per cent—of the entire system of Italian railways. Recognizing this condition the Italian Government, on the one hand, and the Strade Ferrate Meridionali Company, on the other, have cooperated to conduct a test of electric traction, using accumulators, on two lines in Emilia—the Bologna-San Felice line and the Bologna-Modena line. This test, made with the assistance of the Società Italiana di Elettricità già Cruto, was not commenced on the Bologna-San Felice line until the first of May, 1901, reckoning from the commencement of service at reduced rates on that line. Preparation for the test was begun in June, 1900, and in December, 1901, a regular public service was started on the Bologna-Modena branch. The test can then be considered as commencing from the first of December, 1901.

The Bologna-San Felice line is 42.48 kilometres (26.3 miles) in length, and varies in level from 44.96 metres (146 feet) to 17.85 metres (58 feet) above the sea level. The Bologna-Modena branch is 36.93 kilometres (22.4 miles) in length, and this varies in level from 44.96 metres (146 feet) to 34.45 metres (103 feet) above the sea level. On the Bologna-San Felice line the maximum grade is five per cent. It is five and one-half per cent on the Bologna-Modena line after passing San Giovanni in Persiceto. The schedule for this test was draw up holding a motor in reserve, but the results from the very beginning have showed that this was superfluous, so that it has been possible to arrange the schedule of the motor cars to meet the demands of an always increasing traffic.



ACCUMULATOR CAR AND TRAILER.

The rolling stock consists of four motor cars, constructed by the house of Diatto, of Turin, and equipped by Ganz & Company, of Budapest. The cars have two trucks, each having two axles, and equipped with Westinghouse and hand brakes. There are two four-pole series motors and two controllers. Each controller contains two cylinders, one effecting the commutation of the batteries, and the other that of the motors.

The batteries were furnished by the Società Italiana di Elettricità già Cruto, and comprise 266 elements, contained in twelve large cases, four cases constituting a subbattery. Each motor car, therefore, has a battery divisible into three subbatteries, which may be connected in series or in parallel by the controller. In these cases is also enclosed a lighting battery, formed of twenty elements smaller than those for the traction work.

The mounting of the batteries and the table for manipulating the battery sets were designed especially for this service. The mounting is made in the following manner: The elements, reduced to fifteen plates, are contained in ebonite boxes, and these latter in the cases, the case being supported in a framework of iron. The cases are placed under the car body, being slipped in from the side by means of rests on which are mounted a series of wooden rollers. They are slipped into the car by means of a rubber band and are protected by wooden covers. The rollers and rubber are at all times shielded from bad weather, being under the body of the car, and the covers being protected by the exterior cover of the case. The positive and negative terminals of each battery set terminate at a switchboard placed in the baggage compartment of the motor car. The sets of subbatteries are arranged at the switchboard in series, or they may be cut out of the circuit by means of switches, while, as has been described above, the subbatteries are coupled in series or in parallel by means of the controller. By means of a voltmeter and a switch mounted on the switchboard, it is possible to obtain the difference of potential between the poles of each set.

The switchboard accomplishes two purposes, one technical and the other economical. The first is this: If, during operation—which always takes place with three subbatteries in series—a break occurs in the circuit, the motorman perceives this from the falling off in speed; then without leaving his cab he calls the conductor, who is stationed in the baggage compartment, by means of an electric bell. Through a speaking tube the latter is informed of what has happened. He then reads the voltage of each battery set, locates the one where the break has occurred, and cuts it out of circuit by means of the corresponding switch on the switchboard. Not more than two minutes pass from the time when the motorman notices the accident and the time when

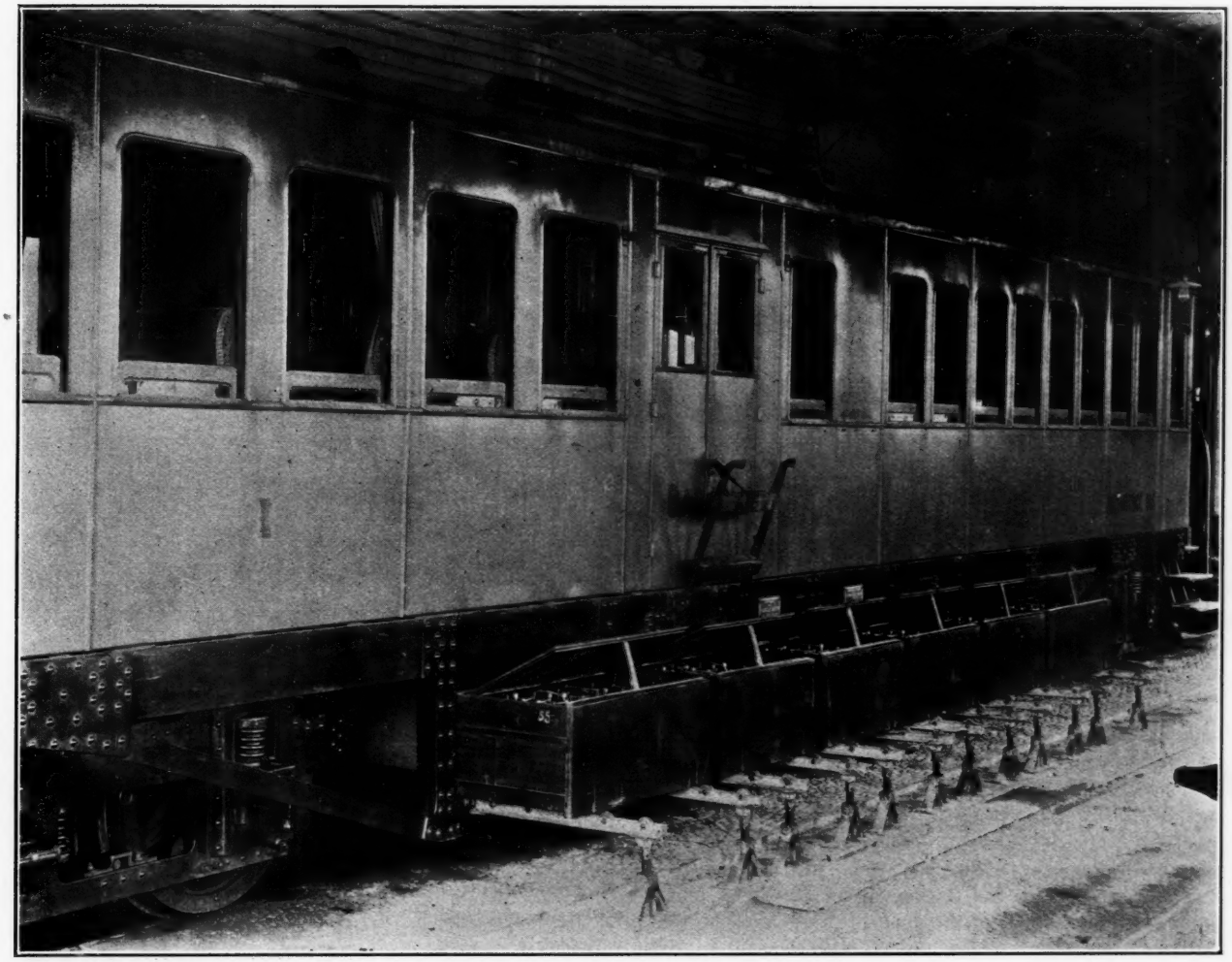
the circuit is completed. The passengers are aware of nothing, as travel is not interrupted, but continues with a voltage reduced by one-twelfth, this condition having little effect on the operation of the car. The service has been so regular that during 188,510 kilometres (116,877 miles) of travel, the switchboard has been called into requisition, in order to cut out a set, but twice.

The other purpose of the switchboard is that of securing the regular operation of the batteries. It is necessary to verify after each discharge the voltage or the density of the solution of each cell, and to correct density if necessary. The cases can be removed entirely from the car, or only partially, with the greatest ease. Two persons can remove the twelve cases in ten minutes. It is necessary to remove them entirely only to renew the plates of an entire battery. They are drawn out partially to examine and repair the elements, and for charging. This is done in the car-shed at Bologna. The cells may also be removed in order to substitute a charged battery if traffic warrants this. The excellent technical and economical results, so different from those experienced heretofore, both in traction on railways and tramways, are to be attributed to the switchboard, the construction and mounting of the cases, as well as to the disposition of special accessories.

Since the commencement of the first trip up to October, 1902—that is to say, during a travel of 188,510 kilometres (116,877 miles)—the locomotive has been called upon but twice to assist the motor cars, due to exhaustion of the batteries—once on September 30, 1901, to draw a motor car and trailer for five kilometres; and again on October 27, 1902, to draw the other motor car over the same distance, this latter occurring after the batteries had been mounted for more than a year. The cause for exhaustion was found to be the disintegration of the negative plates on account of the unfortunate selection of lead sheathes. This being removed, no other trouble has manifested itself. After these troubles—which were produced by a definite cause—were eliminated, service has gone on with the greatest regularity.

The maximum power of the motor cars has been tested on the Bologna-Ferrara line, ninety-four kilometres (58.2 miles) long, with a grade of ten per cent; and on the San Felice-Poggio-Rusco line, 102 kilometres (61 miles) in length. During the tests a regular service was maintained and the traffic on the line has increased greatly on account of the reduction in rates. While in the past this hardly amounted to a mean daily travel of 180 passengers for all the cars, from May to December, 1901, traffic reached a daily average of 832 passengers, and the monthly receipts from merchandise have been 9,000 lire ($1,737).

The Strade Ferrate Meridionali Company, with authority from the government, has constructed at Poggio-Rusco a charging station containing two generators, of 60 kilowatts capacity, each driven by a steam engine, as it is intended to extend electric traction to the new San



ACCUMULATOR CAR—SHOWING METHOD OF REMOVING BATTERIES.

Felice-Poggio-Rusco branch. By charging at two points on the Bologna-Poggio-Rusco line, it is possible to cover the entire line of 60 kilometres (38 miles) with the motor cars drawing one or more trailers. By adopting larger batteries it will be possible to make the entire trip, going and returning, by charging batteries at one terminal.

Many measurements have been made. In one taken recently by Dr. Franco Magrini, manager of the Società Ferrovie Elettriche, in Italy; M. Ettore Morelli, general manager of the Società Elettrotecnica Italiana; Domenico Civita, general manager of the Società Italiana di Elettricità, and Engineers Marievi and Sebastanni, it was found with a mean speed of 33 kilometres (20 miles) per hour, and a maximum of 36.8 kilometres (23 miles), that the traction coefficient was 4.33 kilogrammes (9.5 pounds). During June, 1901, these gentlemen took measurements of the consumption of energy, which was found to be 12.5 watt-hours per ton kilometre at the motor terminals, the average speed being 33 kilometres (20 miles) per hour. The energy required for each charge of the batteries, measured at the terminals of the dynamo (this being taken daily by officials of the Ferrovie Meridionali and of the Società Italiana di Elettricità), was 104 kilowatt-hours. From this it was found that under usual conditions it is not necessary to draw from the batteries more than forty-nine per cent of the energy furnished to them. This accounts for the regular service which can be maintained during the entire winter when snow collects on the line. The average ton kilometres, corresponding to a single charge, is 4,410 ton kilometres (2,734 ton miles); the load being 52.5 tons and the distance 84 kilometres. The consumption of energy at the central station, that is to say, at the terminals of the dynamo, is then

$$\frac{104 \text{ kilowatt-hours}}{4{,}410 \text{ ton kilometres}} = 23.6$$

watt-hours per ton kilometre (38 watt-hours per ton mile). The efficiency of the batteries, measured on a motor car kept for many days in service on the Bologna-Modena line, was

$$\frac{40 \text{ kilowatt-hours discharge,}}{70 \text{ kilowatt-hours charge}} = 0.57$$

of 57 per cent. The schedule speed on that line is 45 kilometres (28 miles) per hour, the maximum speed being 52 kilometres (32 miles).

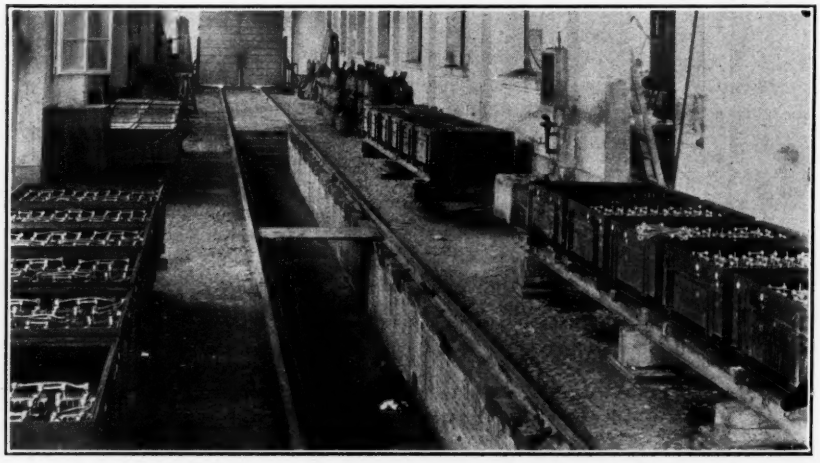
The test on the Bologna-San Felice line was undertaken by the two interested companies, without prejudice, with a serious purpose and all personal opinions were set aside. In this way it has been possible to determine seriously three unknown quantities of the economic problem; the first being to determine the consumption of energy at the central station, which we have seen to be 1,239 watt-hours per train kilometre, or 23.6 watt-hours per ton kilometre (38 watt-hours per ton mile). The second problem is that of determining the life of the plates. It has been found that positive plates of the Faure type have a mean life corresponding to 11,000 kilometres (6,820 miles) travel, and the negative plates a life double this. The weight of the positive and negative plates, as they are constructed at the factory, necessary for a battery, are, respectively, 3,226 kilogrammes (7,197 pounds) and 3,306 kilogrammes (7,273 pounds). Therefore, 4,879 kilogrammes (10,734 pounds) of plates are necessary in order to cover 11,000 kilometres travel. Assuming their cost to be 0.65 lira per kilogramme (6 cents per pound), as an average, the value of the plates will be 3,171 lire ($634). In cells of the Faure type the weight of the worn-out plates is 0.7 of that of the new, so that 3,415 kilogrammes of discarded plates are recovered from the battery, and these have a value of 0.15 lira a kilogramme (1.3 cents per pound), making the total value 512 lire ($102.4). This brings the cost of the plates to 2,659 lire ($530) for 11,000 kilometres travel—that is to say, 2.24 lire per kilometre (7.7 cents per mile) or 0.00456 lira per ton kilometre (0.146 cent per ton mile).

The third unknown quantity is the cost for maintenance of the batteries, inspection, renewing the solution, repairs, etc. This has amounted in the first year of operation to 0.12 lira per kilometre, or 0.00228 lira per ton kilometre (0.073 cent per ton mile).

Bringing together these three figures, and assuming the cost of the energy to be 0.10 lira per kilowatt-hour, we have the following cost per kilometre:

	Per Ton Kilometre Lira.	Per Ton Mile Cent.
For energy	.00236	.076
For renewal of the plates	.00456	.146
For maintenance	.00228	.089
Total	.00920	.031

With respect to the operation of the line, the motorman, who, as well as the conductor, acts between trips as a ticket agent, operates each day two electric trains on the Bologna-Modena line, eight electric trains on the Bologna-San Felice line, and two steam trains.



THE CAR SHED AND BATTERY PITS.

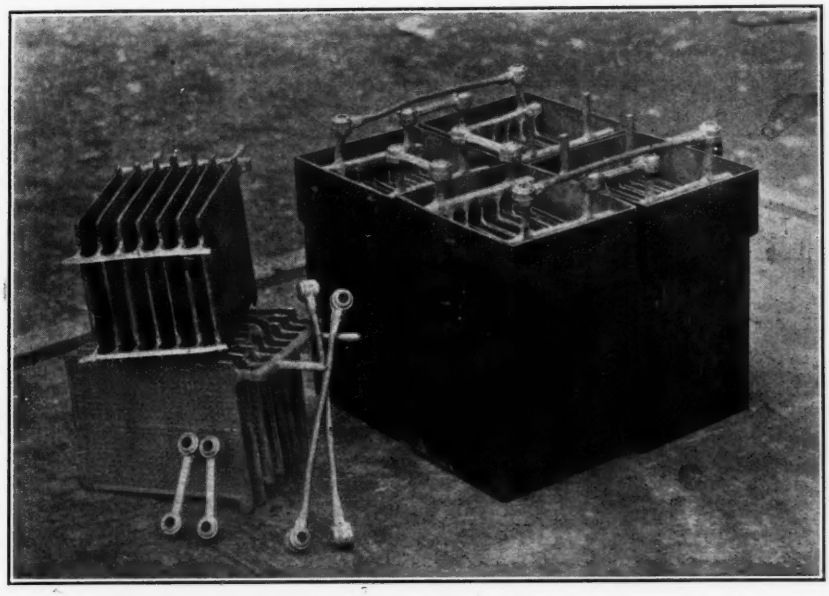
Other costs up to December 31 are these:

	Lira per Train Kilometre.	Cents per Train Mile.
For station superintendent, assistant superintendent and motorman	.1028	3.27
Attendants at the station	.023	0.736
For lubrication	.009	0.288
For maintenance of motor car	.045	1.14
Total	.1798	5.52

To compare the cost of operating by electricity with that of other systems, we may refer to the statistics of the Strade Ferrate Meridionali already published, where the mean cost of a train operated by steam is 1.152 lire per kilometre (36.8 cents per train mile). Steam trains on the Bologna-San Felice line in the first year of its operation cost 0.970 lira per kilometre (31 cents per mile). The cost for electric operation, on the other hand, was 0.7528 lira per kilometre (24 cents per mile). The expense of repairs to the steam locomotives has been assumed equal to the deterioration of the motor cars. That of the battery is included in the estimate.

It should be noticed that during the first year of operation the expenses of

maintenance and renewal of the plates was 0.041 lira per train kilometre (15 cents per train mile), and that with accumulators of the Faure type. There is no doubt that, retaining this type, the expenses will diminish. The Planté type, with which tests have already been begun, Majert positive plates being used, has a considerably longer life and will diminish appreciably the figure just given. In this way, adhering to the results obtained, it has been found that on the Bologna-San Felice line the cost of a steam train is 0.97 lira per kilometre (31.8 cents per mile), while the cost of an electric train is 0.7167 lira (22.8 cents per mile). By a better use of the motor cars, everything else remaining the same, the general cost of station supervision and of small repairs, interest, depreciation, etc., it will be possible to reduce the effective cost with the electric train to



THE ACCUMULATOR USED ON THE ITALIAN CENTRAL RAILWAY.

0.525 lira per kilometre (16.8 cents per mile).

The test of the Bologna-San Felice line furnishes new and accurate data for determining the cost of using water power for accumulator traction. When the economical results of other systems of electric traction are known from the tests, in which the important factors are cost of the energy for long lines, depreciation and interest on the cost of installation of substances and electric equipment, it will be possible to make a comparison of the different systems and to assign to each its sphere of usefulness. At present, from what we have seen above, it can be said that the experience of these two lines in Italy proves, from the technical side as well as the economical, that we are able to take into consideration not only the possibility, but the convenience, of the application of accumulator locomotives. For not a few of the Italian lines this application will be a solution, relatively easy and at once applicable, of the problem of progressive transformation of the traction systems.

THE RELATIVE MERITS OF CENTRAL ENERGY AND MAGNETO TELEPHONE SYSTEMS IN SMALL EXCHANGES.[1]

BY W. A. TAYLOR.

There has been a great many statements made regarding these two classes of service, some of which are in favor of one and others in favor of the other system. It is not the purpose of this article to advocate either system, but merely to show some of the advantages of each.

There is no doubt that with a large exchange system the cheapest and most advantageous service may be given with a central energy. It is only where the system is small that any doubt arises as to which is the best.

We will first consider the exchange which is just starting into business. The first problem is to choose between the two systems. Cost will probably be the first consideration. In an exchange where the instruments and switchboard for a magneto system cost $2,500, the central energy system would cost for the same size approximately the same where primary batteries are used and fifteen per cent more with storage batteries. The difference would lie in the added complexity of the central energy plant in the switchboard. The average help in an exchange of this size is not competent to hunt out the trouble on such a switchboard. In fact, the simplest form of board is usually a considerable problem for him to take care of. So it is necessary to employ a much better man who will demand a higher salary. The battery question has been argued in favor of central energy. To be sure, the matter of inspection is a considerable item in a local battery system, but in an exchange of 200 subscribers one man can take care of the system anyhow, so the matter resolves itself wholly to the cost of batteries. Some form of battery for central energy purposes must be used, which possesses a very low internal resistance; such battery is either some form of caustic soda battery or storage cells. If of the former type, there would be required not less than twenty-five cells, each of which costs as much as ten dry cells, and they would have to be removed as often or oftener. If storage cells are used they must be charged. The charging requires either a charging machine or the reduction of the voltage through a resistance. The charging machine adds to the expense of the exchange, and charging through resistance is notoriously wasteful. If any other type of battery is used the internal resistance is so great that excessive crosstalk is thrown into the system.

The magneto system, taken as a whole, is of course more complicated than the central energy, but as the complication is divided through a large number of telephones, any trouble is not apt to affect the service of the whole exchange. Any battery trouble on a central energy system is liable to throw out the whole system. In order to conserve the primary battery of a central energy system, it is usual to insert a considerable resistance in the circuits. This makes the amount of current for each telephone very small, in fact too small to permit the transmitters to work at their maximum efficiency. If we add to this the resistance of the longer lines, we will find that a certain number of the telephones is given poor service.

The well-designed central energy transmitter will work at its maximum efficiency with a current of 0.15 ampere, and there will not be any very marked decrease in the transmission where the current is reduced to one-half that amount. This gives a permissible line circuit resistance at twenty-four volts of 160 ohms or a line of No. 12 iron about two and one-half miles long. Now, where lines are longer or of higher resistance, there is an immediate falling off of the amount of current and consequently of the transmission. So where long country lines are used the central energy system must give way to the magneto.

Taking a 200-line exchange, there would be 400 cells of dry battery costing in the neighborhood of $60. In the several energy exchanges there would be, in

[1] Paper read before the Wisconsin Independent Telephone Association at Milwaukee, February 12, 1903.

order to have twenty volts, thirty-three cells of primary battery of a type fit for central energy work. These cells would be of 250 ampere-hours capacity, and would cost not less than $65. The dry cells would easily last one year on an average. The central energy cells would last in this exchange, where there were 500 calls a day, each averaging three minutes, not longer than four months unless the current supplied to the lines was so small that the transmission suffered greatly. There would then be something like $130 difference in favor of the dry cells on a local battery system. With storage cells the expense of maintenance would depend upon the rates charged for current. It would require one man to take care of the exchange in either case, though he would be kept busier in the exchange using the local batteries.

The line work for a central energy system must be of the best and so built that there will be a minimum number of crosses to exhaust the batteries.

The central energy system is a little more convenient where the exchange is very busy, as the operator can take care of a larger number of calls. It is not the usual experience in an exchange of 200 that the calls can not be easily taken care of where a magneto system is used.

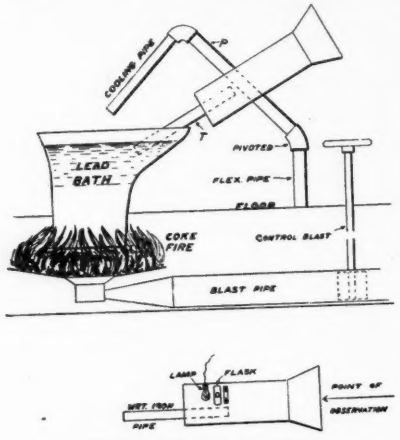
Where it becomes necessary in a magneto system to have more than one man constantly employed in inspection work, a central energy system then is the most economical, for one man can cover twice the ground in such a system than in a magneto exchange.

Another point presents itself and that is, how large must an exchange be before it will pay to change from a magneto to a central energy system? That will, of course, depend upon the condition of the telephone apparatus. Sold as second-hand, telephones will hardly bring enough to make it worth the while to handle them. It is always possible to rewire a telephone and put in the necessary apparatus, and if the instrument is in good condition it is a very good method.

As to the switchboard, it should not be discarded until it has lost its usefulness either because worn out or because it is so low that it can not be used successfully. According to general experience, it has been found that if the new board is to be bought and the exchange is to have as many as 500 subscribers in the near future, it will be advantageous to install a central energy system. It is of course out of the question to put in a central energy exchange of that size unless storage batteries are used. Where these batteries are used it is better to have a source of energy that will never fail. In fact it is much better to have two sources of energy, so that one may always be available.

The Taylor-White Process of Treating Tool Steel.

The Taylor-White process of treating tool steel has been investigated by a committee from the Franklin Institute, which reports upon it in the current issue of the journal. About three years ago an extensive series of experiments was undertaken at the Bethlehem Steel Works by Messrs. Taylor & White to determine the relative efficiency of the various brands of tool steel on the market at that time. There are two classes of tool steel—carbon and air-hardening, the latter being approximately fifty per cent more efficient than the former. In these experiments it was found that the results obtained from different tools made from the same steel varied greatly, and as the only way of accounting for it was by variations in the process of hardening, it was decided to make a thorough investigation of this treatment. A brand of steel was selected



TAYLOR-WHITE PROCESS.

and tools were forged and heated to different temperatures and then placed in a lathe and tested. It was found that those cooled from very high temperatures gave results far surpassing anything that had yet been accomplished. Previous to that time, all hardening had been done by heating the steel to a cherry red and then allowing it to cool gradually or in a blast of air. The results of these tests were so striking that an elaborate series of experiments was carried out, the object being to determine the best chemical composition, and temperatures for treating. A sixty-six-inch lathe belted to a friction cone to secure variable speed was used. The depth of the cut was three-sixteenths of an inch, feed of one-sixteenth of an inch, with a duration of test of twenty minutes, was adopted as a standard. Two hundred tons of forgings were cut up in carrying out this work. The results show that if the tool was heated slightly above the cherry-red point there was a marked falling off in efficiency; thus between the temperatures 1,575 and 1,725 degrees Fahrenheit. the results were poor, but when heated above the latter temperature there was a rapid increase in efficiency with an increase in temperature.

To obtain a suitable steel for this treatment it is necessary and it should be compounded with the chromium in proportion of at least 0.5 per cent, and with another or others of the chromium group of metals in at least one per cent. Better results are obtained by increasing these proportions.

The question of cooling is very important, and it is essential that at no time during the cooling should the temperature rise, but, however, after the tool had been cooled off its efficiency was further increased by reheating to a low temperature ranging from 700 degrees Fahrenheit to 1,200 degrees. The process used consists in placing the tool in a coke furnace where it is gradually heated to a high temperature, the latter being designated at the point at which steel crumbles entrapped with rod. The tool is rapidly then drawn from the furnace and plunged into a lead bath which is maintained at a constant temperature by a special arrangement. In the illustration, the wrought-iron pipe, T, projecting into the lead is enclosed at its upper end in a wooden tube blackened inside. This tube contains a flask illuminated by a small incandescent lamp, the arrangement being such that the color of the flask may be compared with that of the molten lead. The lamps are standardized so that the color of the flask will be the same as that of the lead, that being the desired temperature. The bath is heated by a coke fire through which air is forced. If the temperature rises too high, the pipe, P, through which water is being circulated is lowered into the bath to cool it.

The Franklin Institute subcommittee, consisting of Messrs. Charles Day, James Christie, Coleman Sellers, Arthur Falkenau and Wilfred Lewis, have investigated this process and method to verify the claims made by the inventors. Various brands of air-hardening steel were purchased and hardened in the presence of the committee. These tools were ground to standard angles and tests in the lathe mentioned above. Three test pieces were experimented with, two of steel and one of cast iron. The results are given in tabular form. These show an efficiency of 3.5 to 1 on a hammered forging, 2.2 to 1 on a soft forging and 1.3 to 1 for cast iron. On hard cast iron the efficiency is higher, often reaching 2 to 1. In one of these tests with a cutting speed of 156 feet per minute with a three-sixteenths-inch cut and a one-sixteenth-inch feed the tool was red hot five-sixteenth of an inch from the point, the color being distinctly visible in daylight. At the end of twenty minutes the head of the tool was carefully examined with a magnifying glass and found to be perfect; in fact, the original grinding marks could still be detected. This tool was removing metal at the rate of 356 pounds per hour.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY—VII.

Notes on Progress in Europe and America.

BY JOHN B. C. KERSHAW.

Peat-Charcoal.

A novel use of the electric current is being made at Strangfiorden, in Norway, where a peat-charcoal factory operated solely by electric power, and utilizing 400 kilowatts, derived from water, has been in existence over two years. The process used at this factory is known as the Jebsen process, and it consists in heating the turf by means of resistance coils in retorts of special design.

The peat is brought to the factory by water, and after unloading is first submitted to a mechanical pressing process which removes a large portion of the water, and delivers the peat in the form of briquettes, containing each two kilogrammes of dried peat. The blocks are next submitted to a tunnel-drying process —for further removing the moisture—in wagons of American design. Each wagon carries 140 of the briquettes, and is slowly drawn through two tunnels, heated by the gases from the distillation retorts. The shelf-wagons, with their loads of peat-briquettes, are drawn through against the current of hot air, and thus a maximum drying effect is obtained in the tunnels. The turf is finally charged into the distillation retorts (each two metres in height and one metre in diameter) and is heated by the spiral resistance coils, around which the briquettes are arranged in pigeon-holed tiers.

The retorts are constructed of iron, but are lined with asbestos to minimize radiation losses. The peat under this treatment yields twenty-three per cent of gaseous matter, and a tarry liquid which is worked up for ammonia and coal-tar products. The average yield of air-dried peat at Strangfiorden is said to be as follows:

Peat-fuel, thirty-three per cent; peat-tar, four per cent; tar-water, forty per cent; gaseous products, twenty-three per cent.

The peat-fuel obtained is dense and compact, has a sp. gr. of about 0.30 and a calorific value of 7,250 thermal units. It burns well and yields little soot or ash. It is reported that a ready sale for all the Strangfiorden products is found in Bergen.

Attempts are being made to introduce this process, or a similar one, into Ireland, and there is no doubt that in the near future more attention will be given to the subject of peat utilization in all countries possessing extensive peat deposits. According to the *Engineer* of July 27, a process resembling in some respects the Jebsen process is receiving trial in Canada, but in this case inert gases are used for heating the charges in the retorts in place of electric resistance coils.

Barium and Its Compounds.

The work of the Ampere Electrochemical Company was referred to in a previous note (see ELECTRICAL REVIEW, February 14, 1903), and its success in founding new industries at Niagara was commented upon.

One of these is the manufacture of barium compounds by electrometallurgical methods under the Bradley and Jacobs patents. The process has been fully described by C. B. Jacobs in a paper read before the New York branch of the Society of Chemical Industry, and it is now worked at Niagara Falls by the United Barium Company, which is producing eight to twelve tons of barium hydrate per day, and is planning considerable extensions of its plant. The raw material of the process is the mineral known as heavy spar, or barium sulphate. The production of barium hydrate depends upon the reaction expressed by the following chemical equation:

$$3BaSO_4 + BaS = 4BaO + 4SO_2.$$

In practice the barium sulphide is produced by roasting the sulphate, with the requisite amount of coke, in the electric furnace used for the later reaction between the sulphate and sulphide. The furnaces used are continuous in action, and utilize 500 kilowatts electrical energy. The product of the furnace reaction is extracted with water, and the barium hydrate is obtained from this solution by crystallization. Each furnace yields eight tons of barium hydrate per twenty-four hours. The product is said to be largely utilized for the purification of sugar, for the softening of hard waters, and for the manufacture of paints. It may be pointed out, that the process is practically based on the chemical reactions that have been used for years in the extraction of soluble barium compounds from barium sulphate, and that the chief novelty of the process lies in the use of the electric furnace for carrying out the necessary heating operations. Such use of electricity for heating purposes only leads to economy (1) when a very high temperature is required for promoting the chemical reaction, or (2) when ordinary fuel is expensive and electrical power is relatively cheap. In the manufacture of soluble barium compounds, the temperature required can easily be obtained by the combustion of ordinary fuel, and the electrometallurgical production of barium hydrate, etc., is therefore likely to be confined to a few exceptionally well situated localities, where cheap electric power and a market for the products exist together. It is interesting to note that an electrolytic process for obtaining the same product—crystalline barium hydrate—has been patented, and is being worked in Brussels. In this case an aqueous solution of the sulphide and chloride is decomposed in a cell, provided with a diaphragm. I am of opinion that the industrial future of this process is doubtful, for the unfavorable conditions obtaining in Europe in relation to the use of barium compounds for purifying sugar, and the cost of electrical power in those countries where a good market for barium compounds can be found, will seriously hinder its development.

The Purification of Salt and Brine.

One of the unexpected difficulties met with in the development of the electrolytic processes for decomposing sodium chloride has been due to the impurities present in the salt or brine used as electrolyte. Magnesium and calcium are generally found in variable amounts in rock salt, and when this is used directly in the cells, or when brine pumped from the mines is similarly used, the calcium and magnesium are separated with the sodium at the cathode, and cause loss of efficiency and contamination of the final product—sodium hydrate. It has been reported that at the Weston Point works, England, of the Castner-Kellner Alkali Company, this difficulty assumed serious proportions some time ago, and that it has only been surmounted by submitting the brine used in the cells to a preliminary chemical treatment for removal of the impurities. Vis, in U. S. A. patent No. 642,023, proposes to get over the same difficulty by submitting the salt works mother liquors to a preliminary electrolysis of sufficient duration to decompose the calcium and magnesium salts, and to separate these elements in the form of the insoluble hydrate at the cathode. This process resembles in some respects that proposed by Hall for purifying bauxite, though in the latter case the raw material to be operated on is solid and is purified by electric furnace treatment. It is quite possible that the method proposed by Vis for purifying brine is used in some of the electrolytic alkali works now in operation; but this is one of the points upon which the managers of such works are very reticent, and no reliable information concerning the methods in actual use can be obtained.

An Automatic Telephone Operator.

At the recent meeting of the American Institute of Electrical Engineers, Mr. William J. Hammer read briefly a description of a system of automatic telephone operation. This system is the invention of Mr. Ernest A. Faller, and a careful description will be found in the ELECTRICAL REVIEW of March 22, 1902. Mr. Hammer made a number of interesting comparisons in his paper, showing wherein it might be advantageous to substitute a mechanical operator for the common system of manual service.

Fig. 1 shows the telephone instrument used in this system, and Fig. 2 a diagram of the circuits.

The subscriber's "sender" or calling apparatus consists of a small metal box containing a set of discs, numbered on the periphery from 0 to 9—one comprising the units and the other the tens; and in case of higher numbers being employed additional discs are attached—three discs would give numbers up to 1,000; four discs would give numbers up to 10,000, and five discs up to 250,000. The number of the subscriber to be called is displayed in a line across the "sender" face, and a series of impulses corresponding to this number is sent over the line to the exchange by means of a clock-work started by turning the calling lever projecting upon the front of the "sender." This lever upon being turned upward winds the spring of the clock-work, it then returns to its first position, where it is locked, thus preventing further interference until the call has been sent and properly received at the central exchange. When the "sender" starts the varying series of impulses which is sent over both legs of the metallic circuit simultaneously, the ground (which has been automatically thrown on) is used for a return circuit. The "sender" also contains a magnet whose armature normally retains the clock-work until the magnet is energized by current from the exchange. When the switch is completed at the exchange, the subscriber, as well as the party whom he has called, receives a bell signal. There are four of these signals given to called subscribers, covering a period of thirty seconds' time, this period giving the called subscriber time to reach his telephone. As soon as he has taken off the receiver the signals cease and conversation begins.

All subscribers' circuits are normally free from ground and, as already stated, the subscriber's calling device or "sender" is normally open, both as to ground and metallic circuit.

Each subscriber's line terminates in one place only at the exchange—this being a feature not possessed by other automatic systems—each subscriber's line, consisting of two wires, is connected at the exchange to two parallel rods on the mechanical operator.

These rods are insulated from the rest of the machine, each pair supporting a carriage, mounted so as to slide on these rods.

This carriage holds the subscriber's terminal springs, which are insulated from each other, but each spring makes an electrical contact with one of the two rods.

The springs on the carriage are adapted to slide by, or at some particular point to make contact with one of a series of bars laid in a grid at right angles to and above the carriage rods.

When the subscriber's line terminal switch or carriage at the exchange is at a position of rest, one of the subscriber's line terminal springs makes a contact with the ground spring, which is connected to one of a circle of commutator pins. These pins are swept over by a revolving brush attached to the shaft of what is termed the "busy-wheel" and which is normally in rotation. There are as many pins on the commutator as there are subscribers, and the revolving brush establishes a connection between a ground spring (subscriber's line) and a battery, operating magnet and ground.

The "busy-wheel," to which the commutator brush is attached, is driven by a friction clutch from a power device operated preferably by an electric motor, and is arranged to be stopped by a "pawl" and "ratchet" controlled by the operating magnet, termed the "starting" magnet, which initially controls the entire switching operation of the exchange. The energizing of the "starting" magnet stops the "busy-wheel" and starts the operating gear, which passes through its complete cycle, after which the "busy-wheel" is again started, continuing to revolve until the "starting" magnet is again energized.

A second magnet, termed the "restarting" magnet, is employed to start the "master shaft" going again, in order that the carriage-moving or cord-circuit operating device of the called subscriber may be thrown into gear.

These two "starting" and "restarting" magnets operate in conjunction with the subscriber's "sender" through the medium of a controlling contact apparatus and selector.

The commutator above referred to consists of two sets of circularly disposed contact pins, the number of pins in each circle representing the number of subscribers.

There are also two metal contact rings, one of which is solid and the other divided into ten equal segments.

The rotating trailer arm attached to the "busy-wheel" shaft sweeps over these contacts. The contact pins of one circle are each connected to a separate ground terminal spring; and one of the contact rings is connected in circuit with the "starting" magnet, a battery and ground connection. The purpose of the contact device is to prevent any other subscriber from throwing the "starting" magnet into operation while switching is going on. The circuit in this "starting" magnet being always opened, save when the "master shaft" is at its point of rest, each subscriber's line is brought into connection with the ground, once in each revolution, by the revolving contact arm.

The "busy-wheel," which has been referred to, consists of a shaft extending through the entire length of the "mechanical operator," which carries mounted upon it and disposed around it, in the form of a helix of a single turn, a series of resilient fingers of thin sheet steel, their number corresponding to the number of subscribers.

When the "busy-wheel," which is normally running, has been stopped by an impulse sent through the "starting magnet," one of the steel fingers, which is always the one in a perpendicular position, remains resting against the latch holding that particular subscriber's terminal carriage. Next the power mechanism, acting through a clutch and cam, shoves forward a light shaft, termed a "rack," which is studded with pins corresponding to the number of steel fingers and latches, and which runs parallel with the axle of the "busy-wheel." As this "rack" moves longitudinally, the upright steel finger is bent over by a rack pin tripping the latch and thus releasing that subscriber's rod and shuttle, which drop into contact with a long lantern pinion; this pinion then rotates through an arc dependent upon the number of subscribers' lines busy at that time. Instantly a lever engages the two subscribers' shuttles, lifting them up so that their hook heads engage a shuttle detent. There are as many of these detents as there are talking circuits —*i. e.*, one-tenth the number of subscribers (in this machine the number being ten).

A circuit is now established between the springs of the subscriber's carriage and

the grid bars representing the cord circuit terminals.

The magneto generator is now thrown on the circuit, ringing the bells of both calling and called subscribers. The length of this signal may be varied to suit requirements and is controlled by a timing device. In the meantime, the power mechanism has been automatically thrown out of operation and the "busy-wheel" again rotates until another call is sent in.

When the subscriber takes his receiver off the hook, a "clearing-out" magnet prevents the switch from clearing out; but when both receivers are hung up, the "clearing-out" magnet becomes de-energized, and its armature causes the shuttles connected to return to their position of rest.

INDIRECT OR TRUNKING SYSTEM.

There have recently been made very important changes in the general design of the operator and its mechanical details, without altering the general principles under which the system operates. These changes have greatly increased the speed of making connections, cutting the time down to three and one-half or four seconds for a trunked connection. The new operator is considerably smaller and lighter in weight, more compact, more "get-at-able," and much cheaper in cost of construction. In this machine also is embodied the indirect, or trunking, system, applicable to exchanges from 100 up to 250,000 or more subscribers, uniting all, if required, into a single system without sacrificing the plug and cord principle, and without multiplying the subscribers' contacts, making it entirely practicable to subdivide the lines into groups of 100, thus keeping the dimensions of the connecting machines within moderate limits.

The act of connecting subscribers consists of three functions, each represented by an independent section of the operator. In the order in which these devices are thrown into use in establishing a connection, they are termed the "originator," the "pilot," and the "terminator."

The "originator" performs the office of establishing a connection of the calling subscriber's line with the "A" trunk. These "A" trunks are conductors connecting the "originator" and "pilot," and their number represents the maximum number of subscribers which would at any time be simultaneously using the section. It is well to note here that these "A" trunks always have their beginning and ending in the "originator" and "pilot" of one and the same unit of 100. In this initial act of the "originator," no selective connection controlled from the subscriber's station takes place; but the "A" trunks which are already in use are made inaccessible to subsequent calls, the "originator" always selecting a free and idle "A" trunk. The end of the first free "A" trunk is connected in the "pilot," with a receiver or selector, which immediately upon the establishing of the connection between the "A" trunk and the subscriber's line receives a group-signal referred to later; and thereupon selects a "B" trunk corresponding to the signal received. Immediately the mechanism of the "pilot" connects the "A" trunk and the "B" trunk, at the same time breaking the connection between the "A" trunk and the selector, and putting the selector in connection with the next idle "A" trunk—the "B" trunks referred to connecting the "pilot" and the "terminator."

FIG. 1. AUTOMATIC TELEPHONE INSTRUMENT.

The ends of all of the "B" trunks, coming from one and the same section of 100, are distributed over all the "terminators" of the exchanges, rendering it possible by the aid of one of these "B" trunks to establish a connection between the "pilot" and any one of the "terminators." Here again, as many "B" trunks are provided for each "terminator" as are necessitated by the maximum demand for simultaneous conversations between the two groups.

In the "terminator" the first idle "B" trunk is again connected with a selector which, upon the connection of the "B" trunk with the "A" trunk, receives the number signal. Immediately the connecting machinery establishes a contact between the "B" trunks and the contact element in the "terminator," representing the number of the subscriber wanted, which number has been transmitted to it.

Each subscriber, it will be understood, belongs to a certain group of 100, and in this group he possesses a contact element both in the "originator" and "terminator," these being connected to his line in parallel, protective devices being provided by means of which as soon as the subscriber making a call has caused this particular contact-element in the "originator" to leave its normal position, his corresponding element in the "terminator" becomes inaccessible to other calls, and should any be made they would result in a "busy" signal.

The ringing up of subscribers, conversation and the clearing-out is done in precisely the same manner as in the direct method of connection previously described.

CERTAIN OF THE CONSTRUCTION DETAILS.

The "sender" is identical with that already described and employed upon the original type of the operator. The mechanism at the exchange, as I have already stated, embodies the "originator," "pilot" and "terminator."

The "Originator"—This consists of the switchboard, the movement and "clearing-out device."

The switchboard consists of 100 perpendicular tracks, upon which 100 shuttles independently ride up and down. The track rails are insulated from one another, and connect in pairs to the subscribers' lines. The shuttles consist of two metallic parts in contact with the rails, but insulated from each other, each carrying a contact spring, by means of which they may be brought into contact with the "A" trunks.

The "A" trunks in the "originator" consist of horizontal metallic rods placed

at right angles to the tracks, enabling each one of the shuttles to be brought into metallic contact with any one of the trunk rods. They are arranged in two parallel vertical planes, one in front of and the other behind the shuttle tracks. The ends of these rods are metallically connected to similarly disposed rods in the "pilot." It is self-evident, therefore, that when a subscriber's line is connected to an "A" trunk this is practically an extension of this line into the "pilot."

Each shuttle is provided with an actuating rod, by means of which it may be operated by motive power. In the position of rest, this rod is supported by a trip which, on being actuated by a magnet, allows the shuttle to drop. This magnet receives the current as soon as the subscriber winds his sender—this act resulting in putting the shuttle into its initial working position. The moment the shuttle reaches this position a projection upon its actual rod protrudes in the path of a helical projection mounted on a continuously rotating drum, so that the shuttle is carried into its second working position.

The actuating rod can not be moved further in this direction, owing to a stop in its path; consequently the drum which is driven by friction is brought to a standstill. The moment this happens, the main mechanism is started, actuating the working beam which extends across the entire switchboard. A projection on this beam seizes the shuttle rod and lifts it into the so-called speaking position, *i. e.*, that in which its springs make contact with the first idle "A" trunk.

On completing its stroke, the working beam returns to rest. This stops the connector movement, and the drum driven by friction is again started. The shuttle in the meantime remains in the position in which it was placed. In this position the shuttle actuating rod rests upon a clearing-out bar, which prevents it from dropping back. There are as many as these clearing-out bars as there are "A" trunks. These have a lateral movement, and when moved they release any shuttles which happen to be suspended from them. How this is accomplished will be referred to later.

At the next call the entire operation is repeated, save that the busy "A" trunk is "jumped" and the next one occupied, and so on.

The "Pilot"—In this we find again the switchboard movement, clearing-out apparatus, and in addition a group signal selector.

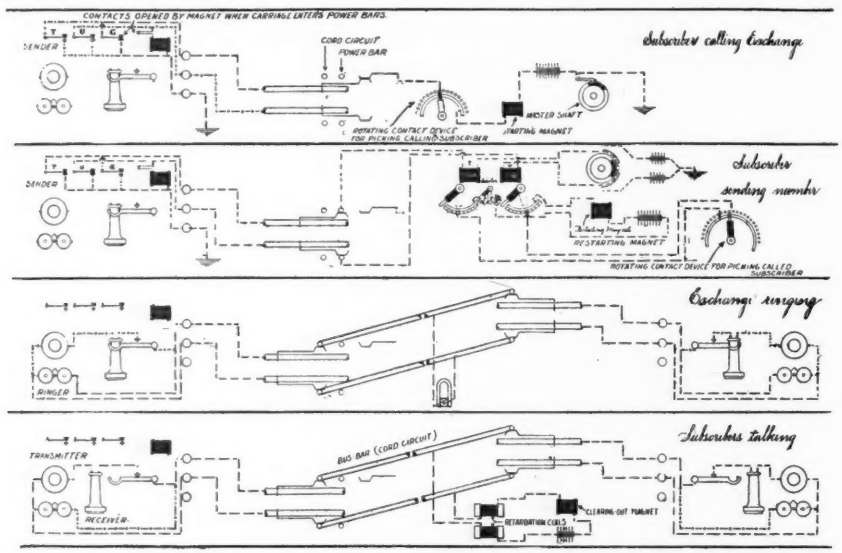


FIG. 2. DIAGRAMS OF CIRCUITS.

All apparatus shown in solid lines; wiring in dotted lines; broken lines show circuits closed; dotted lines show circuits open.

The construction of the switchboard is identical with that of the "originator," save that the drum is eliminated, and shuttle actuating rods pass directly from position of rest into second working position.

The "A" trunks from the "originator" again terminate in rods being provided with a branch circuit to the selector. These branch circuits are normally opened, and are opened during conversation over the trunks, being closed automatically part of the time during the switching act and during the transmission of the group signal.

The shuttles are here connected to rods in the various "terminators," so that the particular shuttle which is selected decides into which groups the subscriber's line will be extended.

The electrical stop motion in the subscriber's sender permits only partial running down of the "sender," but sufficient to transmit that part of the signal corresponding to the first two figures of the number desired. This is the group signal; and after its transmission the selector in the "pilot" causes the particular shuttle to drop into working position. But immediately the shuttle reaches such a position, the actuating movement is started, and, as already described, establishes connection between the shuttle and that one of the "A" trunks over which the signal came. Thus the subscriber's line is continued into that one "terminator" in which the subscriber's line which is desired is located; and it now remains to show how the particular line wanted is selected out of the hundred lines in that group. This will be shown in the description of the "terminator."

It is essential to mention here that the circuit thus far built up has in it a clearing-out magnet and parallel with that a non-inductive resistance, the province of the former being to maintain the established connection until the conversation is finished. A clearing-out in the "pilot" effects a clearing-out in the "originator."

The "Terminator"—Here we find again the switchboard actuating mechanism, clearing-out mechanism, signal selector and the ringing apparatus.

The construction of the switchboard is identical with the ones already described, the 100 shuttles forming the terminals of the 100 lines of the group, and the metallic ends of the terminals of the "B" trunk which meet here coming from the different "pilots," where they had their beginning in shuttles.

All these rods have open-branch circuits to the selector; but one of these branches at a time is closed temporarily the moment the "pilot" establishes connection between an "A" trunk and a "B" trunk. Now the sender is again released, and the transmission is effected. When the signal has been transmitted the selector at the "terminator" affects the dropping of that one shuttle which carries the number wanted; and if its corresponding shuttle in the "originator" is idle, it is thus connected with a "B" trunk, thereby establishing connection between two subscribers.

In the other case the "busy" signal is given to the "originator," and the connection so far established is taken down.

Next, the ringing machinery is actuated, causing the signal at the called subscriber's instrument, this signal being repeated usually four times. It may be any number.

Should the subscriber not answer, the connection is cleared out again.

As soon as the subscriber answers, the ringing mechanism is cut out and the talking battery is thrown in, so that no time is lost. On completion of the conversation the clearing-out magnet with its parallel resistance clears the line.

Economy in Wiring Multiple Switchboards.

At the recent meeting of the Pittsburg section of the American Institute of Electrical Engineers, Mr. Sidney Hand Browne, vice-president and general manager of the Pittsburg & Allegheny Telephone Company, presented the following paper:

In his closing remarks, Mr. Lockwood, in his article entitled "The Evolution of the Telephone Switchboard," refers to the complex organization of the modern relay switchboard and intimates that the next step in its evolution may be along lines which will simplify it rather than in a direction involving a radical departure from its present organization.

A partial simplification has been obtained, resulting in a better "talking circuit," and reduction in first cost and in maintenance. Such simplification consisting of a reduction in the amount of switchboard cable required in wiring the multiple jacks to two-thirds of what is required under the system described; avoiding the use of a shunt to put out the supervisory lamp; dispensing with the use of the repeating coil in the cord circuit as shown, and with the third contact in the multiple jacks.

In the diagram, Fig. 9 (Lockwood's article), it will be seen that the relay which controls the operation of the supervisory lamp, is placed in series on one side of the talking circuit, although there is no corresponding impedance in the opposite side of this circuit. And although this relay is of low resistance, it will slightly unbalance the line, and its insertion in this manner should be avoided if possible.

It is also seen that the test rings of the multiple jacks are connected by a third wire running the entire length of the switchboard. If this third connection could be avoided, it would simplify matters and be a desirable improvement. By reference to the diagram attached hereto, it will be seen that this has been accomplished, with a consequent saving in switchboard cable, first cost of construction, and reduction in cost of maintenance. By dispensing with this third wire in the multiple jacks, we have also been able to use a two-conductor cord instead of a cord with three conductors, as shown in Mr. Lockwood's diagram. This reduces the first cost of cords and their maintenance.

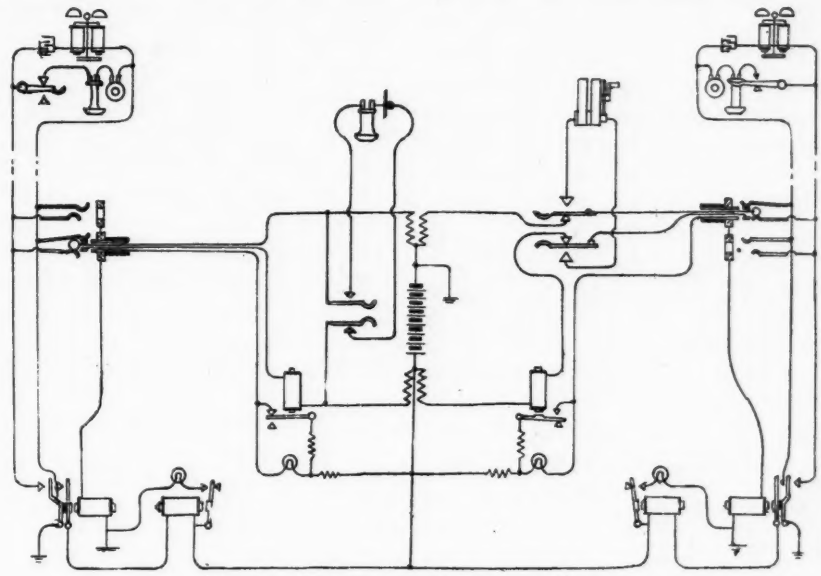


FIG. 9 OF MR. LOCKWOOD'S INSTITUTE PAPER.

It is desirable if possible to avoid the use of the repeating coil in the circuit shown in Mr. Lockwood's diagram, as it is frequently the case that these coils are not properly balanced, and a very slight variation in the size of the core, or inaccurate winding by the manufacturer, will cause enough unbalancing to interfere with the proper working of the circuit. The use of this repeating coil has also been avoided in the system described in the drawing attached.

By shunting the supervisory lamp, as shown in Mr. Lockwood's diagram, when the telephone is taken from its hook, the flow of currents through these lamps and their shunts continues and causes considerable drain on the batteries.

Figs. 1 and 2 show two telephones connected through a telephone exchange system whose operation is as follows:

The action of removing the receiver from the hook of the substation instrument closes the circuit and energizes the line signal relay, X, in the usual manner. The operator, by inserting a plug in the answering jack, allows current to flow over the ring of the plug through a relay, Y, of high impedance, to the ground; this relay, being energized, attracts its armature, Z, and disconnects the line signal apparatus, consisting of relay, X, and lamp, and also "puts current" on the sleeve of the jack which will give the busy test through a relay, T, placed in the operator's circuit. The advantage of this relay controlling the busy test is that by its use the operator only gets the signal, without conveying it to the subscriber who has made the call. The insertion of the plug also causes current to flow through relay, P, closing the local contact at L, and allows current to flow through the lamp to the local contact at L on relay, R, to ground. These relays are of low resistance and are placed on each side of the cord circuit. When the subscriber

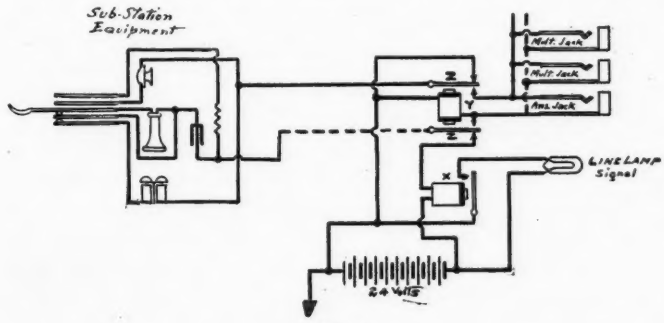


FIG. 1.

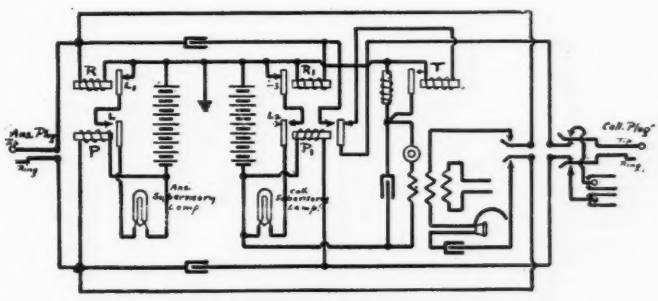


FIG. 2.

answers his call by taking the telephone from its hook, it allows the current to pass back over the tip of the cord to relay, R, to ground and opens the local contact at L, thus cutting out the supervisory lamp. It will be noticed that there is a straight through circuit from the tip and sleeve of the answering cord to the tip and sleeve of the calling cord, with the condensers, C1 and C2, inserted. These condensers permit the flow of voice currents and prevent the steady flow of current from the battery, which simply supplies current for the substation transmitter.

The system described eliminates the features which, we stated above, we did not think were desirable, and, as shown in diagram, Mr. Lockwood's article. It is true we have introduced the relays, R and P and R1 and P1, but these relays are wound to a high impedance and are not connected directly in the talking circuit, but are bridged across it. The circuit is perfectly balanced, which is not true of the circuit as shown in Mr. Lockwood's diagram, and instead of shunting the lamp and allowing current to flow through the lamp circuit, we open the lamp circuit and save the drain on our batteries. To any one who is familiar with the amount of wire necessary in a large multiple switchboard and the consequent greatly increased cost of manufacture, it will be apparent that immense saving can be made by the elimination of one-third of the amount of multiple switchboard cables, as shown in system described by Mr. Lockwood, by the use of two-contact jack instead of three-contact; by the use of two-conductor cords instead of three-conductor, and a much more direct and better talking circuit be obtained.

Electrical Notes from Europe.

By Our Special Correspondent.

ACCORDING to the report made by Privy Councilor Wickert, the administration of the Prussian state railroads has been occupied for some time with the question of train lighting, and has now adopted a solution of the problem, which has been applied to a certain number of trains. The administration decided to adopt the collective system, using a single dynamo, but instead of using one battery to light the whole train during the stops, it was found preferable to install a small battery in each car so that even if separated from the main circuit it would remain lighted for a certain time. It was decided to use a dynamo driven by a steam turbine placed on the engine, which thus charges the batteries of each car. The system is found in practice to reduce to some extent the first cost of the plant and also the maintenance and operation, and satisfies all the conditions of a simple and reliable service. The first trains to use the system are the express trains which run between Berlin and Sossnitz, and the plant was found to work very well. The same outfit is to be installed in a number of other trains. For the general lighting of the car, a type of ceiling lamp is used which gives a very regular light. In the first and second-class compartments have been placed "reading lamps," of which there are two on each side; these can be turned on and off by the passengers. The Berlin-Altona line has also two express trains equipped with a system of train lighting similar to the above, which has been in use since last November. The dynamo is placed on the locomotive, and each car has a battery of thirty-two cells, furnished by the Accumulator Company, of Hagen. The lamps are on a forty-eight-volt circuit and each lamp is provided with a protecting resistance in order to keep the voltage constant, while the battery works alone or is charged by the dynamo. This resistance, which is of a novel construction, is formed of a spiral of fine iron wire sealed in a tube of rarefied hydrogen. It takes up from ten to fifteen volts. The use of iron wire has been preferred owing to its high temperature coefficient, as its resistance increases considerably for a small charge of current. It thus acts to some extent as an automatic regulator. On the locomotive has been placed a generating set, consisting of a De Laval steam turbine working at 20,000 revolutions per minute. A set of reduction gearing gives a speed of 2,000 revolutions for the dynamo. The latter gives seventy volts and 180 amperes. The lighting by this system has proved quite satisfactory. In the first and second-class coaches there are six ceiling lamps of twenty candle-power, besides eight of sixteen candle-power and nine of twelve candle-power, as well as twenty-eight "reading lamps." The current required for the whole is thirty-three amperes. The lamps are placd in two separate circuits, one of which can not be closed except when the train is running. The voltage of the lamps is kept within such close limits by the use of the automatic regulators that it is impossible to tell whether they are running on the dynamos or on the battery alone.

A short three-phase line which uses 3,000 volts direct to the motors is that which has been installed at Völlersdorf, Austria. This road, which has been constructed under the direction of the Austrian War Department, is used to transport freight and raw material from the railroad station to the government establishment at Völlersdorf, which is thirty miles from Vienna. The line is less than a mile long, and the three-phase system was chosen, in the first place, because the current could be obtained from a neighboring station and also in order to test the system of three-phase motors working at high potential. The current is at present furnished by a steam plant and also by a hydraulic plant situated a few miles off. The cars are drawn by electric locomotives of fifty horse-power. At present but one of the axles is equipped with a high-tension motor, while the second may be used later on. The locomotive measures 13.3 feet net length and the body proper is 6.6 feet long by 7 feet wide. The electric outfit has been furnished by Ganz & Company. Current is taken from two overhead trolley wires, with a rail return. The two trolleys are of the usual type and each mounted on a separate pole, while the upper ends are connected by a cross-brace. This arrangement forms a parallelogram which can be swung about its axis, and the movement is carried out by compressed air, which acts upon a piston at the base of each trolley pole. Owing to the high tension which is employed, special care has been taken to secure good insulation. The 3,000-volt motors have a stationary field and rotating armature which makes 600 revolutions per minute and has a 4.8-inch pinion which engages with a 28.8-inch gear to operate the axle, thus giving a one to six reduction. This allows a normal speed of ten miles an hour for the locomotives. The armature is provided with three collecting rings which are connected to the starting rheostat, which consists of a set of metal plates immersed in a liquid. The overhead line

is formed of two hard-drawn copper wires, eight millimetres in diameter and spaced twenty inches apart with a height of twenty feet above the rails.

The Southern Railway Company of France has installed a large electric plant to supply its depots and shops at Bordeaux, which occupy a considerable area and employ over 1,000 men. A large amount of motive power is needed to run the various machines and this was formerly supplied by twenty steam engines of different kinds distributed over the premises and varying from five to one hundred horse-power. In the new system, electric motors have been substituted for the engines, and these are supplied from a large central station which is located at the middle point of all the shops. The station supplies direct current at 240 volts on the three-wire system. At present three generating sets of 500 horse-power have been installed, giving a total of 1,500 horse-power, with a place reserved for a fourth group. Corliss engines are used with the dynamos, which are twelve-pole machines and give 1,400 amperes and 240 volts, or 336 kilowatts. To supply the lighting and power for all the buildings an extensive feeder system is needed. Eight main feeder cables leave the station. Their total length is eight miles and the sections vary up to 250 square millimetres. For the lighting of the premises 250 arcs and 2,700 incandescent lamps are used. The power circuits supply forty-three electric motors of various sizes up to sixty horse-power; also three electric capstans for the manœuvre of the trains, which use five-horse-power motors. The total motor capacity is thus 775 horse-power. Several special applications of electric power to the requirements of the railroad service have been introduced, which are of considerable interest. One of these is the electric operation of the turntables for shifting the locomotives and cars to the different tracks. The current is brought by an underground cable to two copper rings which are fixed side by side on the supporting pivot of the revolving platform. The rings are about four and one-half feet in diameter and are well centered. Over the rings pass two brushes which are fixed to the platform and are connected to the motor by lead-covered cables. The motor is placed on the platform in a special form of shelter or house and works a rolling wheel by a set of gears; the roller bears upon a circular rail and causes the platform to revolve by adhesion. A controller placed beside the motor allows the platform to revolve in either direction and the speed is regulated by a rheostat. In case the exact position is not obtained when the platform stops it is slightly shifted to bring it into place by a hand-wheel. In this way the motor is relieved of the sudden shock of starting and stopping. The electric capstan has also proved very successful for carrying out the manœuvre of the trains. It has been designed so as to occupy as small a space as possible, owing to its position in the railroad yard, where there is but little room between the tracks owing to the numerous crossings and switches. The capstans are operated by a five-horse-power motor built by the Societe Alsacienne. It is designed to run at 1,400 revolutions per minute when empty and 700 at full load. This allows the capstans to make 105 or fifty-two and one-half revolutions. The capstans are enclosed in a tight case and are made as weather-proof as possible. The cover is made in three parts, one of which is hinged and gives access to the starting switch and resistance, also the brake which is used to lower the speed at starting. The cable enters the box by a tight joint and passes to the switch through a main circuit-breaker. The handle of the latter is accessible through an opening in the top cover. The current may then be broken when the operation is finished and prevents the improper use of the capstan. The weight of the whole apparatus is about three tons. One of these capstans is used for operating a turntable forty feet in diameter for shifting the locomotives. It not only works the platform but also draws the locomotives and cars upon the turntable and distributes them to the different tracks.

An important hydraulic plant now in construction in Switzerland is that which is being erected near Lake Joux, from which the power is to be taken. The central station is to supply two distinct circuits, the first being a three-phase line to furnish power for the motors used in different industries throughout the region, and the second a two-wire circuit for the lighting. When the station is fully equipped it will have ten turbine sets. At present five of these have been installed. The turbines, which have been built by Escher, Wyss & Company, of Zurich, Switzerland, give 1,000 horse-power and are of the horizontal type. They are coupled direct to three-phase alternators, which have been furnished by the Oerlikon Company. The alternators, which work at 375 revolutions per minute, are wound so as to give three-phase or two-phase current at 13,500 volts and fifty cycles. At present there are two exciters installed, each of which is coupled to a 150-horse-power turbine, giving 125 volts at 750 revolutions per minute.

Some interesting experiments have been carried out in Germany by Haber and Geipert in order to find the best process for obtaining aluminum in the electric furnace and to determine the proportion of the material to be used. For this purpose they use a mixture of equal parts of fluoride of sodium and alumina. The proportion of fluoride is made large so as to give a greater fluidity to the fused mass. The current density used in the electric furnace is three amperes per square centimetre, and the voltage varies from seven to ten volts. In this way a remarkably pure metal is reduced, as may be remarked from the fact that one sample contained only 0.05 per cent of carbon and 0.034 per cent of silicon. The metal showed a breaking strain of fifteen kilogrammes per square millimetre. Their experiments led them to conclude that the high efficiency of the commercial processes which are now used in the various establishments are not due to a secret method of manufacture, but rather to the care which is taken to eliminate the impurities of the raw material. They also found that the carbon which the metal contains is simply mixed with it and not in a state of combination, and it can be eliminated by giving the metal a second fusion. As all the impurities of the carbon electrodes are found in the reduced metal, it is important to use as pure a carbon as possible. C. L. DURAND.

Paris, February 7.

Proceedings of the Engineers' Club, of Philadelphia.

The January issue of the proceedings of the Engineers' Club, of Philadelphia, contains a number of interesting and valuable papers. Three articles consider fire hazards and fire protection. Mr. John C. Trautwine, Jr., takes up "Fire Mains," Mr. John E. Codman describes the high-pressure fire service at Philadelphia, and Mr. Washington Devereux discusses "Some Electrical Fire Hazards." These papers were all fully discussed. There is also a description of the Guayaquil and Quito Railway in Ecuador, by Mr. William D. Beatty; a discussion by Mr. Carl Hering of "The Latest and Best Value of the Mechanical Equivalent of Heat," and "A New Method of Testing Wire," by Mr. Arthur Falkenau. The minutes of the club are also given in this number.

Two Years' Rest for Edison.

[From the New York Sun.]

Thomas A. Edison, in a stain-spotted suit and an old slouch hat drawn well down on his forehead, straightened himself up from a dilapidated little table over which he had been bending, threw a stub of pencil down on a yellow pad of paper, and settled back in an armchair.

"At last," he said, "I've finished work on my storage battery and now I'm going to take a rest."

He gazed thoughtfully out of a window of his laboratory office for a moment.

"For I'm tired—very tired," he added simply. "I'm all worn out."

The next second his eyes twinkled merrily.

"Yes, I've planned for a great vacation," briskly and enthusiastically, "and it will begin after I've spent a few weeks in Florida, where I am going in a few days. And the best part of it all is this—it will last two years."

Mr. Edison rubbed his hands in anticipatory joy.

"I'm going to have a fine time—splendid time—during these two years. I'm just going to rest. Yes, sir; that's what I'm going to do, and I'll tell you how I am going to do it.

"Up in my house across the street I've a big book of over 400 pages filled with notes that I've jotted down from time to time during the last fifteen or twenty years. They relate to things that I've observed while working out my various inventions, and I've simply put them down and done nothing with them, because I've not had time to investigate these various incidental phenomena.

"Now, however, I'm tired—thoroughly tired—and I've made up my mind to drop industrial science for two whole years and rest myself by taking up pure science—by investigating the thousand and one properties of metals and chemicals that I've got notes about in my book.

"Strenuous vacation? Not a bit of it. All I'm going to do is what every pure scientist does—the fellow who finds out the actions of metals and chemicals under different conditions and in various combinations by experimenting, but who does not apply the results industrially.

"Guided by my notes, I'm going to mix things in laboratory mortars and chemists tubes and what not, and watch for results. That's all pure science does.

"It never thinks things out, like industrial science. It just blunders, stumbles against discoveries, while industrial science is the result, in greater part, of concentrated and consecutive thought.

"It will be fun and maybe I'll find out something worth while—who can tell? Anyway, I'm looking forward to a real good time, and, I believe, that, by hustling a little, I'll be able to investigate everything that I've notes about in my book."

What his notes relate to, Mr. Edison will not disclose, except to say that one of his investigations will be conducted toward finding a wood that will be a good substitute for coal, when that fuel becomes more scarce and a great deal more expensive than at present.

"I firmly believe," said Mr. Edison, "that the time will come when we in this country will secure most of our heat from wood in some form or other. The wood that will be used will come largely from tropical South America, where sprouts spring into full grown trees in three or four years.

"Then the vast Amazonian forests will be worked and nourished on a scientific basis by capitalistic syndicates and the world's fuel supply thus conserved for all time. And science will find a way to make the wood almost as good for heating purposes as coal. Perhaps it will be used something after the manner of charcoal—I believe that charcoal will some day be pretty generally used in the place of coal.

"But don't think that we'll live to see all this. The coal supply in this country is far greater than most people imagine. Immense deposits in the Hudson Bay region are waiting to be opened, and great lignite beds are still unworked.

"Only after these and the present mines are worked out will people turn to the forests of tropical South America for their fuel. When that will be, time alone can tell—perhaps not before the days of our grandchildren's grandchildren. But sooner or later it will come, and it won't do any harm for me to follow up certain observations about tropical wood as fuel that I jotted down in my book years ago. It'll all be a part of my rest, you know, and recreation means pleasure, doesn't it?"

Mr. Edison thinks that the growing of wood for fuel on land in temperate America would not prove remunerative enough for serious undertaking.

"There are thousands of acres of now uncultivated land in this country, admirably adapted for such a purpose," he said, "but the scheme is impracticable for the simple reason that our climate is not tropical enough to ensure quick growth to the trees.

"After an acre was once cleared of wood, it would take sprouts six or eight or ten years to attain sufficient size for fuel purposes. This fact alone militates against such a plan to provide a substitute for coal.

"Some enterprising fellow, though, could make a small fortune by securing control of several thousand acres of land of this description already wooded and harvesting the crop. I have about 25,000 acres of stunted woodland up in the Orange Mountains and I've figured out that each acre is capable of supplying the fuel equivalent of a ton of coal.

"Just now in my laboratories I'm burning a lot of this wood, thus outwitting the men who these days are getting two or three times the usual price for coal.

"The scheme to secure heat by boring down to the earth's centre also appeals to me as being impracticable, except in volcanic regions. There the earth's crust is thin and the molten matter comparatively near the surface; hence, it could be easily reached and obtained by means of pipes sunk down to it and utilized for manufacturing and heating purposes.

"In the non-volcanic regions, the crust is too thick and the molten interior so far distant that to reach it by boring would be a too problematical undertaking for invested capital. And that part of the world is non-volcanic where heat is needed for bodily comfort, and fuel-consuming industries thrive.

"But while many men are busying themselves with these and other schemes to secure heat, on the other hand, if the signs of the times count for anything, I believe that the next few years will witness a great development of hitherto unworked coal fields by big manufacturers. The late coal strike has proved to them that they must have their own mines, and in this way be independent of outside operators and ensure against enforced closing down of their mills for lack of fuel.

"I happen to know of several owners of industrial establishments who are already seeking to secure and work coal lands, and these men assure me that many of their rivals are aiming in the same direction."

Here Mr. Edison reverted to his vacation.

"Now that I'm about to take a rest and am beginning to get a true perspective of the last twenty years of my life, I begin to realize more than ever before how very little I know—how very little I have accomplished.

"Why, with all my work in electricity

I don't know what electricity is. True, I've thought out several inventions and made my brain and body weary thereby, and I've got my name noised about, but what have I done—what do I know—after all?

"Why, simply this—very little, hardly anything, when we think of the things still to be done and still to be learned of the forces all around us that we don't understand in the least, that we scarcely dream of.

"Yes, sir, that's the gospel truth. But, say," Mr. Edison's eyes laughed merrily—they are eyes that never lose their sparkle and fire, no matter how tired the rest of their possessor's body may be—"perhaps I'll learn a little bit of the unknown during my two years' vacation. Anyway, I'm going to work hard to do so, and I'm going to have a fine rest."

BOOK REVIEWS.

"Design of Dynamos." Sylvanus P. Thompson. New York. Spon & Chamberlain. Cloth. 253 pages. 6½ by 9 inches. Eight plates, four colored wiring diagrams, and many illustrations. Supplied by the ELECTRICAL REVIEW at $3.50.

This book is a valuable addition to Dr. Sylvanus P. Thompson's useful series of text-books on dynamo machinery. Dr. Thompson has the faculty of presenting even the most difficult questions in such a way as to retain the interest of the reader and student, at the same time making them easy to grasp. In this respect this book does not differ from the others. Indeed, any one interested in dynamo machinery will find this very pleasant and instructive reading, while to the student who has just taken up the subject of the design of electrical machinery, it will give a clear insight into the proper methods of procedure. The author does not believe that every one can become an expert and successful designer, for no one has yet ever designed a successful dynamo by mere rules. Time and experience have taught the general lines along which dynamo design must proceed; but the work itself remains an art requiring the constant use of judgment, as well as a thorough knowledge of the abstract theory.

Chapter two of this book takes up magnetic calculations; chapter three, copper calculations; chapter four, insulating materials and their properties; chapter five, armature winding schemes, and chapter six, estimates of losses, heating and pressure drop. After laying this foundation, the question of design is taken up in chapter seven. The various methods of procedure are discussed and compared, and rules are given and applied in numerical examples. Some typical examples of dynamo design are critically discussed in chapter eight, full data being given. The book contains three appendices, giving complete wire tables and specifications for continuous-current design.

"Electricity as Applied to Mining." Arnold Lupton, G. D. A. Parr and Herbert Perkin. New York. D. Van Nostrand Company. Cloth. 280 pages. 6 by 9 inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $3.50.

The growing use of electricity in and about the mines created a demand for a text-book especially dealing with the subject in relation to its mining applications. The aim of the authors of the present volume is to present to the reader the main principles of electricity and electrical engineering, without going into great detail, their intention being that he should have recourse for further information on the theory and practice of the subjects of electrical and mining engineering to some of the many standard works already in existence.

In the first chapter, thirty pages are given to an introduction to the subject of electricity, its laws and units. The second chapter treats of the theory and construction of dynamos and motors and transformers, with particular reference to machines for mining work. The question of driving a dynamo is taken up in the third chapter, which gives a brief study of reciprocating engines, with some photographs of their performance. Next is considered the application of the steam turbine, and in chapters five, six, seven and eight, the general rules for the distribution and measurement of electrical energy are taken up. Chapters nine and ten treat of the electric motor as applied to pumping, hauling and other mining work. In chapter nine is given some data of recent typical mining plants. The electric lighting of mines is rather too briefly touched upon, while other appliances, such as signal bells, mine firing and electrical methods of lighting lamps, are given considerably more space. A comparison is made of electrical and other methods of transmitting power, and the dangers of using electricity are discussed, together with methods of locating faults. It is impossible to treat of this subject thoroughly in a book of this size, but this volume gives a satisfactory review of the art as it is to-day.

"Secondary Batteries." E. J. Wade. London, England. Electrician Publishing Company. 492 pages. 265 illustrations and diagrams. 8¼ inches by 5 inches. Supplied by the ELECTRICAL REVIEW at $4.00.

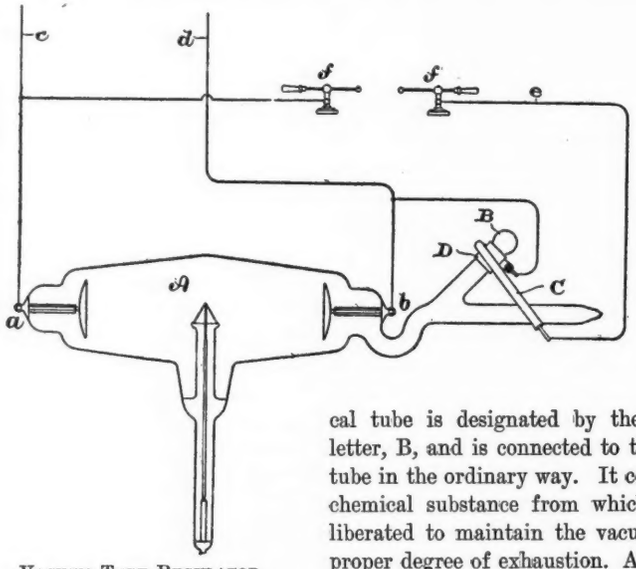
The need of a clear and sequentially arranged work on the storage battery has been admirably met by this book. FitzGerald, it is true, has given us an able treatise, but this is of assistance only to the chemist or the engineer engaged directly in the manufacture of batteries. Dolezalek has produced, probably, the clearest and most practical work on this subject that has yet appeared, but it has never been translated and only those engineers who read German can avail themselves of its valuable contents. Mr. Wade's book covers practically the whole subject of secondary batteries, and includes not only the familiar lead-lead cell, but also those which have electrodes of other metals.

There are ten chapters, the first being introductory. The second is historical and shows the various forms through which the lead cell has passed from the beginning of the art up to the present time. Chapter three discusses those cells other than lead. Chapter four, on the "Properties and Behavior of Lead Cells," is good and practical, treating mainly the physical phenomena that affect the working of lead cells. Chapter five, on the "Chemistry of Lead Cells"—the polymerization theory—which Mr. Wade first put forth in 1900 before the British Institution of Electrical Engineers, is given. It will be recalled that most of the authorities on batteries who discussed the paper at the time of its presentation, while admitting its ingenuity, did not accept it, and were practically unanimous in their belief of its fallacy. Chapters six and seven, on the "Design and Manufacture of Lead Cells," are necessarily incomplete, as these two subjects would, if exhaustively treated, form a volume larger than the work under review. The information and suggestions given in the seventy pages allotted to this portion of the book are helpful and of value. Chapter eight covers the treatment and testing of lead cells, and this chapter, though good as far as it goes, is not quite complete from a practical standpoint. This criticism also applies to chapter nine, on the "Erection and Regulation of Lead Cells." Chapter ten, under the heading, "Present-Day Cells," is exhaustive, and, together with chapter two, probably makes the most complete record of the various forms and types of electrodes that has ever been included between the covers of a single book.

The book, as a whole, so far surpasses anything on the storage battery that has yet appeared in the English language, that the criticism offered can not detract from its value, and Mr. Wade is to be congratulated on producing a work which is so replete with solid information, and which evidences such careful and painstaking effort. It, however, should be added that it is more academical than practical, and obviously the production of a student and theorist rather than an engineer.

Electrical Patents.

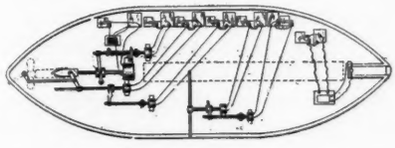
It is well known that by long continued use the vacuum in an X-ray tube will become higher and higher, so that eventually the tube becomes no longer serviceable by reason of the increased resistance to the passage of the current. To obviate this defect, certain tubes have been invented which have a glass bulb containing a chemical substance which will liberate a vapor upon the application of heat. When the vacuum in one of these adjustable tubes becomes too high for the current to pass, the bulb is heated and a vapor liberated which lowers the vacuum and makes the tube temporarily active. Great care has to be used in this operation, however, for if the heat is too great or is applied for too long a time too much vapor will be liberated. The vacuum will then become too low for the generation of X-rays, and the tube will have to be cooled sufficiently to condense the excess of vapor. If the heating process is performed carefully, so that the proper degree of vacuum is produced, the tube will then operate well for a few minutes until the vapor condenses by cooling of the bulb, when the vacuum will rise and the heating process must be repeated. With these tubes the heating has been accomplished ordinarily by a lamp or flame placed under the bulb. From the foregoing explanation it will be seen that a simple and effective automatic arrangement for regulating the heat applied to the chemical bulb and preserving the vacuum constantly at just the proper degree is highly desirable for a variety of reasons. Such a simple and cheap device has been invented by Mr. William S. Andrews, of Schenectady, N. Y., and a patent recently obtained thereon has been assigned to the General Electric Company. The regulator is so made that it can be easily attached to an adjustable tube and removed therefrom, so that the temperature regulator is an entirely distinct piece of apparatus from the tube and its life is not at all limited to the life of any given tube. Mr. Andrews has demonstrated its practical usefulness by a careful series of experiments and has found that it will regulate the vacuum with great accuracy, while its operation is entirely automatic. The illustration herewith presented is a diagrammatic view of the improvement applied to an X-ray tube. A, having its electrodes, *a b*, connected to the opposite leads of the external circuit, *c d*, in the way usually employed in operating these tubes from an alternating-current circuit. The chemical tube is designated by the reference letter, B, and is connected to the vacuum tube in the ordinary way. It contains the chemical substance from which vapor is liberated to maintain the vacuum at the proper degree of exhaustion. A shunt circuit, *e*, is connected around the terminals of the tube and in it is included a spark-gap having terminals, *f f'*, which are adjustable so as to vary the length of the spark-gap, and, consequently, the resistance of the shunt circuit. In series in the shunt circuit is also included a small resistance or electric heating device, C, so located that the heat developed therein regulates the liberation of the vapor from the chemical tube. Many kinds of resistance material may be used, but the most successful and that preferred is an interrupted conductor forming a succession of small air-gaps, across which the current passes, producing sparks and consequent heat. This conductor is preferably looped about the chemical tube, a copper thimble being interposed between the two. When the apparatus described is in use, the spark-gap will be adjusted to suit the power of the apparatus and the degree of vacuum required. When the current is turned on, the operation will be as follows: Assuming that the vacuum in the tube is too high, so that it offers too great a resistance to the current, the resistance of the shunt-circuit will be so adjusted that a certain amount of current will pass through the resistance and spark-gap in series with it. Heat will be generated in the resistance, thereby heating the chemical bulb and liberating a vapor which will lower the vacuum in the tube and decrease its resistance. The X-ray tube will then begin to fluoresce and grow brighter and brighter until normal fluorescence is reached. At this stage the flow of current across the shunt-circuit will substantially cease, provided the adjustments have been properly made, since the tube now offers an easier path. Sufficient current will, however, continue to pass at intervals through the spark-gap to keep the chemical bulb at a certain temperature, dependent upon the distance between the terminals of the spark-gap and the working potential. When the vacuum tends to rise by cooling of the tube, and the resistance increases, more current then flows through the shunt circuit, restoring the normal resistance of the two paths and maintaining proper vacuum. By regulating the length of the spark-gap, any desired degree of vacuum may be produced and maintained in the tube. Since the electric heating device is a distinct piece of apparatus from the vacuum tube, the two articles can be separately manufactured in ways most appropriate to each. The expense of the X-ray tube is not increased, as it would be were regulating devices incorporated in and made a permanent part of it, and, furthermore, the life of the regulating apparatus is in no wise limited by the life of the tube. The resistances may simply be kept in stock and applied to the tubes as occasion may require. Experience has proven that by the use of this simple automatic device, the tubes will give uniformly good service for a practically indefinite length of time.



VACUUM TUBE REGULATOR.

It is now proposed to employ the "wireless" system of electrical transmission for the purpose of operating vessels, torpedoes and the like from a distance. A patent has just been obtained by Lida Wilson, of Brooklyn, N. Y., on mechanism of this sort. The mechanical operations may be of various kinds—as, for instance, the operation of machinery upon a vessel for the purpose of propelling and directing such vessel and to perform various other functions, also

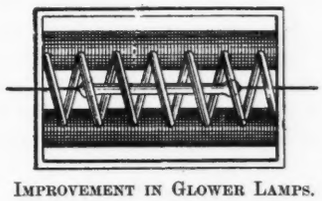
mechanism for closing an electric circuit to ignite a torpedo or explosive charge upon a floating vessel or in a subaqueous or subterranean mine. The impulse transmitted to a wireless receiver of electricity would in such case be used to initiate the operation of the electric circuit required to produce the igniting spark. The wireless transmitter, attuned to operate in unison with such wireless receiver,



WIRELESS OPERATION OF VESSELS.

may be upon a floating vessel or upon land. Where a number of mechanical operations are to be performed, a series of the wireless receivers may be employed to initiate the movements of the several mechanisms, and a corresponding series of wireless transmitters, each synchronized and attuned in unison with one of said wireless receivers, would be used to initiate such mechanical operations independently, so that each receiver can only be influenced by a transmitter attuned in sympathy with it. In many cases the various mechanisms may be advantageously actuated each by an electric motor and storage battery carried upon the vessel, and the movements of each motor and the resulting operation are initiated by means connected with the wireless receiver of electricity upon the vessel. The ignition of an explosive charge, whether upon a craft, torpedo or in a mine, is correspondingly effected by the use of a wireless receiver to close an electric circuit and direct a spark into the charge to explode the same. A series of motors to perform different functions upon the same craft may be set in operation by a series of wireless receivers constructed or attuned differently one from another, but each adapted to operate sympathetically synchronously in unison with a special one of a corresponding series of wireless transmitters located at the same or at different distance stations, so that each receiver can only be influenced by a transmitter attuned in sympathy with it. The transmitters may be connected electrically with a kite or mast, which may be placed vertically, inclined or horizontally.

Mr. Henry Noel Potter, of New Rochelle, N. Y., has devised another improvement in glower lamps, and Mr. George Westinghouse, of Pittsburg, has purchased the patent obtained thereon. Some of the standard forms of electric lamps, in which originally non-conducting bodies, known as "glowers," are brought to a conductive state by external heat and maintained in a state of incandescence by the electric current which then traverses them, are provided with electric heaters arranged alongside and substantially parallel to the incandescing elements. These heaters are often in the form of tubular bodies of heat-resisting material wound with platinum wires, by means of which the preliminary heat is developed. When a lamp so constructed is arranged with its axis horizontal it sometimes happens that the lamp fails to start, owing to the fact that the air currents, rising against the glower, cool and prevent its being sufficiently heated. The present invention is designed to provide means whereby the glower shall be protected against such rising currents of air, and to this end a screen is employed having its meshes or ribs sufficiently close together to serve the purpose indicated without interfering seriously with the radiation of light. A thin spiral of pure zirconia is preferably used, which surrounds the glower quite close to it and



IMPROVEMENT IN GLOWER LAMPS.

constitutes a sufficient screen for the purpose. The use of a close spiral or similar cage-like screen has the further advantage of increasing the efficiency of the glower by confining the heat which lengthens the life of the glower and assists in making up for the losses by absorption in the cage. The cage may be made of quartz, in which case it would be transparent, or other refractory material might be selected and the meshes or ribs can be made in other shapes besides the spiral illustrated.

Proposed Electrochemical and Metallurgical Society in England.

A meeting was held recently in London to consider the organization of an electrochemical and metallurgical society. The object of this society was explained by Mr. James Swinburne, and a formal motion that a society be formed was made by J. W. Swan, and seconded by Mr. Alexander Siemens. The following officers were elected: President, Mr. J. W. Swan; vice-presidents, Lord Kelvin, Professor A. A. Crum-Brown, Sir Oliver Lodge, Dr. Ludwig Mond, Lord Rayleigh, Mr. Alexander Siemens, and Mr. James Swinburne, and Dr. R. A. Lehfeldt. The council contains, in addition to the officers just named, Messrs. George Bailby, Bertrum Blount, W. R. Cooper, Sherard Cowper-Cowles, A. G. Charlton, Dr. F. G. Donnan, Professor A. K. Huntington, Dr. W. S. Squire, Dr. O. J. Steinhart and Dr. F. M. Perkin.

A Correction from Professor Pupin.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In the issue of February 21 of your esteemed journal you say in the closing paragraph of an editorial commenting on Mr. Hewitt's mercury vapor interrupter: "Dr. M. I. Pupin . . . said to the editor of this journal: 'The Cooper Hewitt mercury vapor interrupter at once establishes wireless telegraphy on a commercial basis . . . and transatlantic transmission will be easy.'"

I deny this statement most emphatically. I never made it to you nor to anybody else. My authorized interview, published in the same issue, closes with the sentence:

"The Cooper Hewitt mercury vapor interrupter . . . is the very thing needed to extend wireless telegraphy . . . away beyond its present limits. How far this extension will reach I am not prepared to say . . ."

This sentence contradicts the statement which you attribute to me. I consider myself competent to express an opinion on the purely technical side of Mr. Hewitt's work, which I have watched closely, but I certainly am incompetent to judge when an invention has reached a commercial basis. Not knowing anything about the difficulties connected with wireless transmission across the Atlantic as practiced by Mr. Marconi, I certainly can not tell anything about the ease or difficulty with which this transmission can be practiced with the Hewitt interrupter. Nothing but a most lamentable absence of common sense on my side could have prompted such a statement as you attribute to me, and in that case you ought to have suppressed it, the statement being on the face of it a foolish one, and painfully discordant with the statements given in my authorized interview.

Yours truly,

M. I. PUPIN.

Columbia University, February 24.

[Professor Pupin was understood to make the remark quoted in the editorial. We regret if he was misunderstood, and are pleased to publish his letter in respect to the matter.—ED.]

Reviews of Current Engineering and Scientific Literature.

The Dimensions of Large Inductance Coils.

It is sometimes desired to construct large coils of known inductance. Mr. James E. Ives has recently had occasion to calculate a number of such coils, and here gives the record of his results. The formula used was that given by Maxwell. Seven coils of varying dimensions were constructed of No. 18 B. & S. double-cotton-covered copper wire. The centres of the wires were assumed to be one-twentieth of an inch apart. The following table gives the results of these calculations:

	Length of Wire in Feet.	Number of Turns.	*a* in Inches.	*b* in Inches.	*c* in Inches.	Inductance in Henrys.	Remarks.
I.	5000	2625	3.13	2.75	2.75	0.72	
II.	5000	2625	3.75	5.00	1.50	0.85	
III.	5000	2230	4.36	2.36	2.36	1.05	Maximum for 5000 feet.
IV.	5000	2230	4.36	4.30	1.29	0.92	
V.	5000	1940	5.00	2.20	2.20	1.04	
VI.	5000	1940	5.00	4.00	1.20	0.93	
VII.	10000	3530	5.50	2.97	2.97	3.33	Maximum for 10000 feet.

The mean radius of the coil in inches is given as *a; b* is the length of coil and *c* is the radial depth. From this table it is evident that the coil of maximum inductance must have a square cross-section. The inductance of a given coil increases rapidly as the mean radius is increased up to the maximum inductance, and then, as the mean radius is increased still further, decreases slowly. For coils of maximum inductance, the inductance increases very rapidly as the length of the wire increases —not quite as fast as the square of the length.—*Abstracted from the Physical Review (New York), February.*

Electric Omnibuses in Italy.

An electric omnibus was exhibited by the Societa Alta Italia at the recent Exhibition of Modern Decorative Art, at Turin. The advantages claimed for this vehicle are the doing away with of all track construction and maintenance, and the less obstruction to the regular traffic because of the absence of rails. This particular omnibus consists of a car body resembling slightly the familiar type of street car. It is divided into three compartments, those at the ends being enclosed, the central one, where the passengers enter, being open. The body is mounted on two trucks. Each truck has one axle, and on each axle is mounted with a spring suspension a small railway motor. These drive the axles with the Grisson transmitting apparatus, the efficiency of which is given as ninety-three per cent. Both axles are movable and are connected by two cross-ties, so that the motorman guides the vehicle by turning both axles simultaneously. Current for operating the omnibus is collected from two overhead trolley wires, contact being made to these by two independent trolley poles, on the end of each of which is a slipper which is so designed as to prevent jumping from the wire. Each vehicle is fitted with a controller of the usual type, a guiding wheel, and electric brakes. The car is lighted electrically. The voltage of the supply is 500. The omnibus is capable of accommodating twenty-two passengers, but it can also draw a trailer. It weighs 9,900 pounds. Some tests were recently made to determine the tractive effort required for this vehicle, as compared with a street railway car weighing 2,200 pounds, the latter running on rails. The starting effort required for the omnibus was from 880 to 1,100 pounds, this figure being practically the same as that required for the car. The tractive effort on a good road was found to be 550 pounds, and on poor roads, 1,100 pounds. For the car the figures varied from 400 to 460 pounds. —*Abstracted from the Electrical Review (London), February* 6.

The Radio-Active Material, Polonium.

Mme. Curie here corrects an impression which has arisen from her previous publications respecting polonium. This is to the effect that she had come to the conclusion that polonium was not a new element, an inference which was not warranted by the statement that she had not as yet been able to prove that it was a new element. In the course of her work on radio-active materials, Mme. Curie discovered, in collaboration with M. Curie, two new and very powerful radio-active substances, and a study of these suggested the existence of two new elements, polonium and radium. So far, they have not been able to prove that polonium is a new element. It resembles bismuth in its chemical reactions and its spectrum. The following observations, however, seem to indicate that polonium is distinct from bismuth. By fractional precipitation of nitric acid cells with water, the precipitate is more strongly active than the solution. With fractional precipitation from strong acid solutions by means of carbon bisulphide, the sulphide is more active than that which is thrown down later. By sublimation of the sulphide in vacuum, the active sulphide is more volatile than the inactive. Concentration by this means gives a substance which differs more from bismuth than the untreated material. The precipitates thrown down from the nitric acid solution differ in color from white through a gold-yellow into a red-brown. These may be merely concentrated preparations of polonium. It is possible that polonium possesses no visible spectrum. These preparations of polonium show a dying-out radio-active power with time, certain of them falling to one-half their value in eleven months, but still showing strong discharging power and photographic effects.—*Abstracted and translated from the Physikalische Zeitschrift (Leipsic), January* 15.

Thermoelectricity and a New Thermopile.

Herr Albrecht Heil has been interested in thermopiles for many years. He has carried out many experiments for determining the efficiency of the usual couples used, for finding better and more efficient materials, and for improving the design of the apparatus. He shows that much of the data heretofore accepted as authoritative is incorrect. This is particularly true of the temperatures given for the melting points of the metals and their alloys, and in a number of cases it is possible to increase considerably the temperature of the hot junction without injury. The author's work shows that certain alloys possess a much greater thermoelectric power than the pure metals. The best results are obtained by using two alloys; one consisting of sixty per cent of copper and forty per cent of nickel, the other of 122 parts of antimony and sixty-five parts of zinc. This couple gives an electromotive force per pair of 0.045 at a temperature difference of 230 degrees centigrade,

and an electromotive force of 0.130 with a difference of temperature of about 500 degrees centigrade. Various proportions of the constituents of these alloys were tried, but the figures given were the most satisfactory. The author next takes up the question of design, and shows that soldered parts are unsuitable, as the solder melts at a temperature below that desirable for the hot junction. He prefers to use brazed joints. However, better results were obtained by connecting the two alloys together through a sheet of copper, and applying heat to the latter. The proper proportion for the elements was considered. Figures of the performance of this thermopile are given, which show that for twenty-five watt-hours, a consumption of 1,000 litres of gas is required. This is an equivalent of a consumption of 200,000 gramme calories per watt-hour, while the calculated value should be 864 theoretically. The efficiency is therefore 0.86 of one per cent, and the useful energy at the maximum output of the thermopile is a half of this, or 0.43 per cent. This performance is compared with that of a small steam engine, and is shown to be better. Thus, the heat required per watt-hour for the thermopile is 72.2 calories, while that for the engine and dynamo is 83.3 calories.—*Translated and abstracted from the Zeitschrift für Elektrochemie (Breslau), January 29.*

The Electric Lighting Plant of Barnstaple, England.

Recently the Barnstaple (England) municipal lighting plant was put into operation. Barnstaple is a modern town of 13,000 inhabitants, and feeling the need of a modern lighting system, it constructed an up-to-date plant at a cost of £21,600 ($108,300). One unusual feature of the work has been the wiring of private buildings by the corporation. The plant is located on the bank of the River Taw, where ample water supply for condensing purposes is obtainable, while a railway passes close to the building. In addition there is a quay for discharging coal from vessels at the site selected. The generating station is a two-story structure in front and contains a large battery room and testing room on the ground floor. Officers' rooms are on the second floor. Back of these is the engine room and in the rear the boiler room. The latter contains three Babcock & Wilcox boilers, each capable of evaporating 5,000 pounds of water per hour, and each is fitted with a Babcock & Wilcox superheater, capable of superheating steam to a temperature of 500 degrees Fahrenheit. A Green economizer is arranged in sections so as to be easily split up in case of need. The engine room is seventy-one feet long by thirty-two feet wide and twenty-three feet high. The chimney is of square section, eighty feet high. In the engine room are three compound vertical engines, directly connected to three generators. The engines each have three cylinders, the space above the piston acting as a high-pressure cylinder, and that below as a low-pressure cylinder. The dynamos have each an output of 250 amperes at 500 volts, running at 450 revolutions per minute. They are of the direct-current, compound-wound, six-pole type. There is, in addition, a booster and balancer set in the engine room. The switchboard is of enameled slate, and is fitted with the latest applianees. The accumulators are arranged in two batteries of 120 cells each. Each feeder consists of three separate cables. These are laid solid in wooden troughs. Provision is made for extensions to the outlying districts by means of separate conduits laid in the same trenches of th existing mains. For street lighting, circuits are run containing five arc lamps each. After midnight these are cut out and incandesecent lamps, fixed to the same poles, lighted in their stead. A considerable number of Nernst lamps is used throughout the town. Current for lighting is supplied to consumers at a flat rate of twelve cents per kilowatt-hour. For power purposes the rate is six cents.—*Abstracted from the Electrical Engineer (London), February 6.*

Electrical Transmission of Pictures.

A number of ways has been proposed for transmitting images electrically, and one or two have been worked up into more or less practical form. There are two classes of apparatus—those which reproduce, bit by bit, the figure to be transmitted, and those which give an image of the whole object. It is a method belonging to this latter class which is here described by Herr Von St. Schneider. This system makes use of the Pollak-Virag rapid telegraph recorder and a selenium cell for effecting the necessary variations in intensity of illumination. At each station two telephone receivers are connected to a small mirror so as to vibrate this in two directions. Corresponding telephone receivers are connected together, and within each circuit is placed a revolving contact maker. One of these contact makers makes and breaks the circuit a certain number of times for each revolution, and this, of course, sets up corresponding vibrations of the two telephone receivers in that line. The other breaker does not actually break the circuit, but introduces a gradually increasing resistance, starting at zero and rising to a maximum, and then dropping to zero again. The effect of this is to produce a comparatively slow motion of the two telephone diaphragms connected in that circuit. When these two contact makers, which are connected to the same shaft, are revolved, a beam of light, reflected from a suitable source upon a screen, will travel gradually over the entire screen; starting at one end, working its way back and forth to the other, and then jumping to the first point again. The method of transmitting is this: A beam of light from an arc lamp is allowed to fall on the mirror at the sending station. By a suitable grouping of lenses, the beam is thrown horizontally through a photographic negative, and is then focused on a selenium cell. The effect of this will be to vary the current in the circuit containing this cell, corresponding to the intensity of the light falling upon it. The circuit from this cell is carried to the receiving station, and there the current is superimposed upon the current flowing through an electric arc. One ray from this arc is thrown upon the receiving mirror. The intensity of this ray varies with that falling upon the selenium cell; and since the ray traces a path on a receiving screen similar to that which the sending ray follows, the result is a production of a copy of the photograph at the receiving station. It is, of course, necessary that the image be repeated at least ten times a second to give a constant effect upon the retina.—*Translated and abstracted from the Electrotechnischer Anzeiger (Berlin), February 5.*

Copper Smelting and Refining in Montana.

In the eighth biennial report on agriculture, labor and industry in Montana, is given many interesting and valuable statistics relating to copper smelting and refining. The number of establishments is given at seven, with a capital of $26,824,298, apportioned as follows: Land, $309,346; buildings, $9,195,526; machinery, tools and implements, $2,349,499; cash and sundries, $14,969,927. The number of salaried officials is 107, with salaries of $233,711, and the average number of wage earners 4,290, with a pay-roll aggregating $3,791,903.60. This is but one of the phases of mining practice in Montana.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Tread-Kill Shaking Grate.

The style of grate herein illustrated and described is known among engineers of power plants as the Tread-Kill shaking grate, and is manufactured exclusively by M. H Treadwell & Company, 95 and 97 Liberty street, New York.

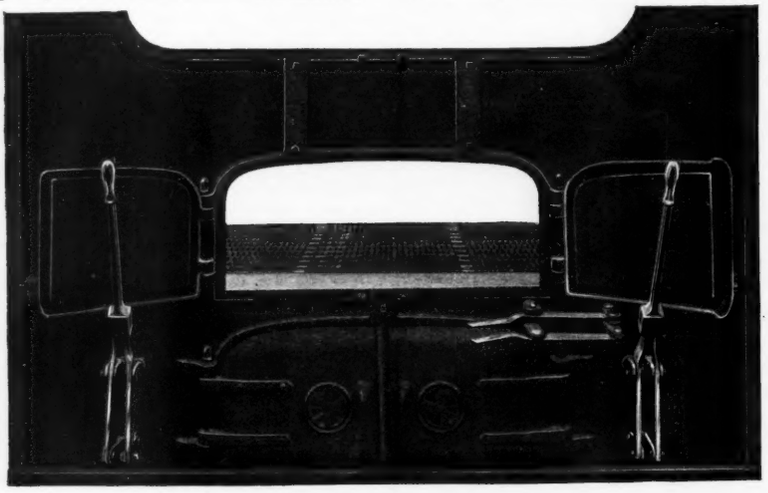


FIG. 1.—THREE-BANK GRATE WITH TWIN LEVERS.

It is of most modern and improved design, being so constructed as to give a maximum strength with a maximum air space. It is applicable to all styles of boilers, being in use under every known type, and each set is built especially for the furnace it is intended to occupy.

They are made for every size furnace, particularly for the large horizontal and water-tube boilers. The grate consists of rocking bars which are set in a frame and operated by means of levers attached to the front.

The grate is made in sections of such dimensions as to absolutely prevent warping. The side and centre carrying bars, forming the supports for the rocking bars, are of massive design, substantially constructed for the weight carried by them. They are so constructed as to receive the trunnions on the ends of the rocking bars. The wearing surfaces being protected, adds materially to the ease with which a grate loaded with fuel may be shaken, and at the same time reduces the wear to a minimum.

Special attention is called to the compact and simple construction of the grate as a whole, combined with the strength of each individual bar, every member being designed so as to prevent warping.

No part of the grate, under the severest conditions, will break or burn. These bars are made to burn all kinds of coal, including the larger grades of anthracite and bituminous, and also the cheaper and smaller sizes, the air space being provided to facilitate combustion.

FIG. 3.—THREE-BANK GRATE ILLUSTRATING SHAKING MOVEMENT.

M. H. Treadwell & Company are also builders of boiler fronts, but they build the Tread-Kill grate so as to make it applicable to every style of front.

Fig. 1 shows a three-bank grate with twin levers arranged to shake in six units, three front and three rear. The handles, fulcrums and jaws are made of the best quality malleable iron, while the shaking levers and rods are of forge steel.

These grates are manufactured at the Myerstown, Pa., works of the above-mentioned company, and every set of grates is fitted up in complete working order before shipment.

Fig. 2 shows the following parts: (1) bolt for jaw with washer and pin; (2) jaw; (3) pipe carrier support; (4) bolt for link and lever connection; (5) shaking bar (top view); (6) handle bar, single connection; (7) handle for double connection; (8) shaking bar, bottom view; (9) bolt for connecting bar; (10) connecting bar; (11) end stationary grate; (12) bolt for fulcrum; (13) fulcrum.

Fig. 3 shows a grate, three banks wide and two units deep, and illustrates the shaking movement, which will break clinkers and clean the fire instantly from front to rear, where free burning coal is used.

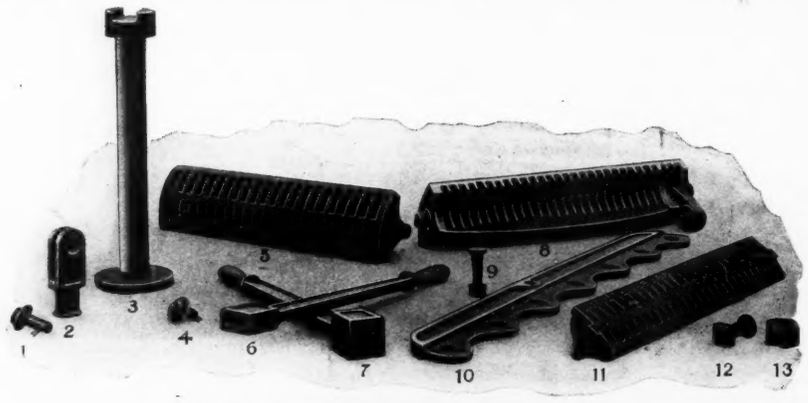


FIG. 2.—ADJUSTABLE PARTS OF SHAKING GRATE.

These grates have recently been installed in the several following power-houses: Rockland County Light and Power Company, Orangeburgh, N. Y.; Bergen County Gas and Electric Company, Hackensack, N. J.; power-house, Lebanon Steam Plant, Lebanon, Pa.; central station power-house, Reading terminal, Pennsylvania & Reading Railroad, Philadelphia, Pa.; Tarrytown Water Company, Tarrytown, N. Y.

A New Lineman's Climber.

In the accompanying illustration is shown a new lineman's climber which has recently been placed upon the market, and which is the result of a careful designing to eliminate any structural weakness or disadvantages of older styles. This climber is made of borasic steel, hardened

A New Type Climber.

and tempered by a secret process and covered with a heavy coating of white metal chemically prepared. This makes it absolutely rustless and obviates entirely the danger of loose or broken rivets. The spur is welded in, making practically one piece. The loops are made in the forging, and the combination makes one of the safest and most complete climbers yet designed.

This climber is manufactured by the Smith & Hemenway Company, 296 Broadway, New York city.

The Universal Gear-Cutting and Milling Attachment for Lathes.

The accompanying illustrations show a new attachment for lathes which will take the place of gear-cutting and milling machines for many kinds of work. It is designed for use by tool and model makers, experimental and all workers desiring to do fine, accurate work. The bracket piece which contains the driving mechanism is attached to the cross-feed slide of the lathe in place of the regular tool block. The driving arbor which runs through this bracket piece transmits motion to the upright or cutter spindle by means of a pair of spiral gears which are encased so that they are free from dirt and chips. The driving arbor receives its motion from the head-stock lathe spindle through a train of three spur gears, one of which is screwed on to the nose of the lathe spindle and has a wide face. Any of the regular change gears furnished with the lathe may be used for the other two driving gears and by using different combinations a large number of speeds for the cutter may be secured. The intermediate gear is on an adjustable quadrant which swivels on the frame piece and allows a cross movement of the entire frame piece and slide rest and accommodates the cutters to the various sizes of work. The automatic longitudinal feed or the hand-crank may be used to feed the cutter to the work.

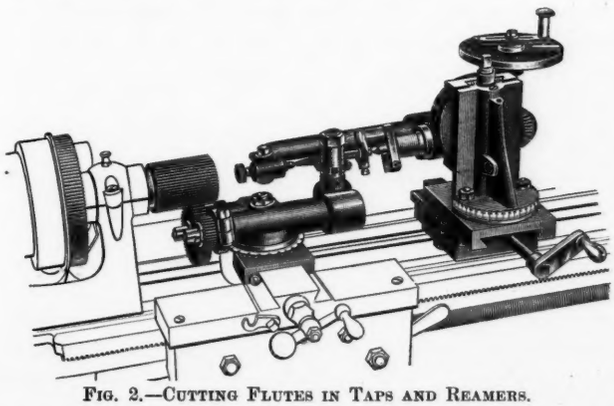


Fig. 2.—Cutting Flutes in Taps and Reamers.

The base of the swivel dividing head is securely clamped to the lathe bed by means of two bolts and a binder plate and has longitudinal, cross and vertical feeds which are operated by a hand-crank. The upright part swivels on the cross-feed slide, which is graduated and renders it capable of fine adjustment to any horizontal angle. The frame piece, containing the spindle, indexing mechanism and the overhanging arm, swivels on the vertical feed slide which is graduated and allows fine adjustment to any vertical angle. By means of these two feed adjustments and the cross and vertical feeds, cuts of any desired angle may be made.

For milling operations requiring a vise, the frame piece, containing spindle and indexing device and overhanging arm, is removed and the vise arrangement is attached to the vertical slide. This may also be swiveled to any angle. In using this vise arrangement, the milling cutters may be driven by the head-stock spindle.

Chucks, centres, etc., may be used on both the head-stock spindle of the lathe and the spindle of the swivel dividing head, as the taper holes and nose of both spindles are of the same size.

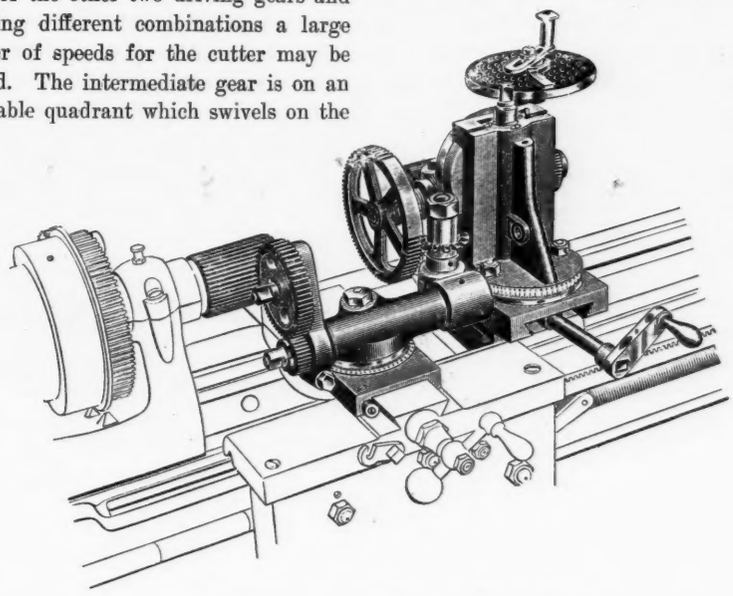


Fig. 1.—For Cutting Spur, Bevel or Mitre Gears.

Gears may be cut as large as the swing of the lathe. A complete index is furnished and all number of teeth may be cut from one to fifty and nearly all numbers up to 360. Brown & Sharpe or any standard milling and gear cutters can be used.

Fig. 1 shows the attachment arranged for cutting spur, bevel or mitre gears, milling cutters, etc. Fig. 2 shows the attachment arranged for cutting flutes in taps, reamers, etc.

This attachment is designed by the Seneca Falls Manufacturing Company, 420 Water street, Seneca Falls, N. Y., U. S. A., for use on the well-known "Star" foot and power engine lathes, nine-inch to thirteen-inch swing.

A New Internal Combustion Engine.

The Westinghouse Machine Company, whose three-cylinder, vertical, single-acting, internal combustion engine is well known, has been for some time engaged in developing the double-acting engine, and it is now prepared to build this type for powers ranging as high as 3,000 horsepower. As this type of engine possesses features somewhat novel to those accustomed to the usual reciprocating engine design, a brief description may be of interest.

Fig. 1 shows a perspective view of a single-crank engine of the new type. Fig. 2 that of a double-crank engine.

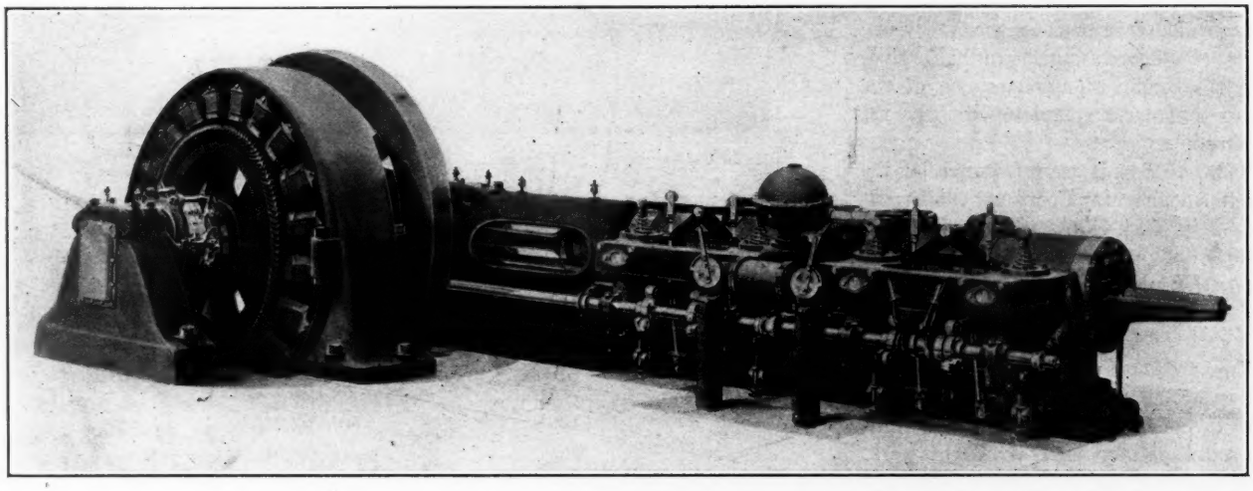
The general design of the engine resembles to a noticeable extent that of a modern high-speed tandem-compound steam engine in the arrangement of cylinders, frames, bed-plates, bearings, flywheel and generator. This resemblance is further carried out in the matter of crank effort. Each and every revolution is accompanied by two impulses, one occurring at each successive in-stroke and out-stroke. The engine operates, therefore, upon the four-stroke cycle, involving distinct periods of admission, compression, explosion, expansion, and exhaust; a cycle yielding the highest practical, as well as theoretical, thermal efficiency and economy of fuel.

The employment of the four-stroke cycle involves a feature of the greatest importance, that of positive scavenging. The engine under description scavenges thoroughly and completely upon the return stroke of the pistons, which then draw in their charge of explosive mixture, undiluted either by products of combustion or by scavenging air.

In direct distinction from the use of an explosive mixture varying in richness according to the load, this engine employs a mixture of unvarying quality, which is initially proportioned according to the nature of the gas used, but which remains constant under all conditions of load. As the load upon the engine increases or decreases, a corresponding greater or lesser quantity of mixture is admitted to the cylinders, thus utilizing at all times an explosive mixture of maximum strength, resulting in higher thermal efficiency and economy of fuel.

The construction of the engine is in many respects unique, in that it departs materially from the accepted European design, and embodies many established features of modern steam engine practice, which have been so instrumental in bringing about the success of the well-known Westinghouse vertical, single-acting type. From crank to cylinders, the construction is that of a horizontal steam engine suitably strengthened in proportion to the increased maximum pressure resulting from the rapid combustion of the highly compressed gases. The design of cylinders, pistons and valves, of course, departs materially from steam engine practice. The cylinders are double walled, with the outer walls split peripherally to permit independent expansion and contraction without placing the cylinder casting under stress. The two cylinders are united at the top by heavy tie rods, engaging peripheral bosses, and at the bottom by a stout cast-iron distance-piece. The rear section of the bed-plate which supports the two cylinders is cored hollow with a central dividing wall and serves as a reservoir for incoming and outgoing circulating water. All connections are piped directly to these reservoirs, thus avoiding a large amount of piping about the engine. Through the bed-plate extend the four vertical exhaust pipes, which connect immediately below with an exhaust main. The exhaust passages leading from the valve chambers are cast integral with the cylinders, upon their under sides, and are water cooled.

At the ends of each cylinder occur horizontal side ports, resembling straight steam ports, which communicate with removable combustion chambers. The cylinders are closed by water-jacketed heads, those located between the two cylinders being split diametrically for facility in inspection of the interior, and the two halves are united with a ground fit, no packing being found necessary. This feature obviates the necessity for completely dismantling the engine for inspection.



[Copyrighted 1902 by the Westinghouse Machine Company.]

SINGLE-CRANK, DOUBLE-ACTING INTERNAL COMBUSTION ENGINE.

The location of the valves and combustion chambers in the new design is especially fortunate, and the contrast between the simplicity of this arrangement and the formidable complexity of numerous European types is striking. The arrangement shown in the accompanying illustration accomplishes the same purpose at far less cost and with less complexity. The combustion chambers are independent castings with plain machined faces, circular valve-liner seats, and cored-out passages for circulating water. Both admission and exhaust valves, which are of the standard poppet type, operate vertically and with opposite throw. They open by cam movement and are held to their seats by spring pressure. The central space, closed by the admission valve above, and the exhaust valve below, communicates directly

with the cylinder port before mentioned; the exhaust space with the exhaust passages on the under sides of the cylinders; the admission space with the supply pipe. This supply pipe is a rectangular cast-iron main extending along the entire front and provided with openings opposite each admission valve. It receives its supply from the governor chamber located midway between the two ends, this in turn communicating with a mixing chamber supplied on the one hand with gas and on the other with air through suitable valves. These two valves are shown in Fig. 1, and are provided with graduated indices, so that the exact proportions of gas and air may at all times be visible, and under the control of the attendant. Another feature of the greatest importance is found in the provision for interchangeable parts. Each valve, together with its spindle and seating spring, is independently mounted, and by simply removing the bolts from the bonnet, the entire valve, seat and liner may be drawn out for inspection or replacement by a spare. Similarly, the igniters, which are of the "make and break" electrical contact type, employed in all Westinghouse engines, are mounted in a removable plug extending into the combustion chamber through the side walls.

The valve gear is of the standard cam and roller pattern, also employed in the Westinghouse vertical engines, and is driven by a helical gear, engaging a similar split gear bolted around the main shaft.

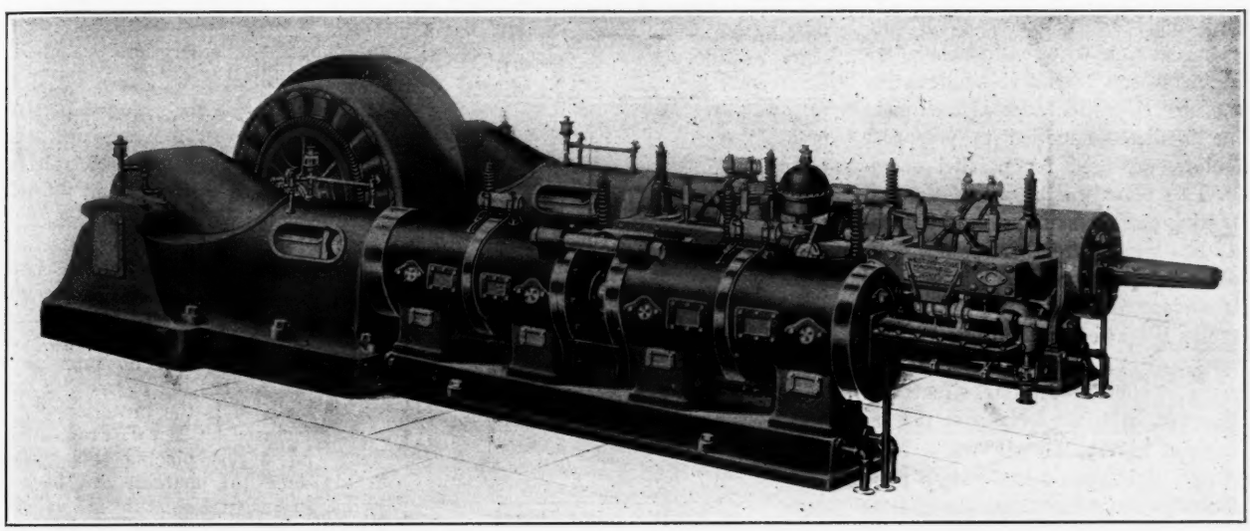
The method of circulating cooling water through the pistons is unique. This water enters a cavity on the cross-head by means of a flexible pipe connection provided with special swinging joints. It then flows through the hollow piston-rod to the front and rear pistons, through which it circulates, finally emerging through a bronze tail rod extending through the rear head, there emptying into a cast-iron jacket communicating with the hot-water return pipe. Similarly, cold water is conducted through suitable pipes to the cylinder jackets, thence to the jackets surrounding the exhaust valves and ports, and finally to the return pipe, emerging at a sufficiently high temperature for use in heating and drying coils, regulators, etc. By the above method the proper temperature relations between pistons and cylinders are at all times secured, thus allowing close piston fits to be employed without danger of excessive friction or rupture. This point may be more readily appreciated from the fact that a cold piston clearance of approximately one-sixteenth inch is necessary in moderate-sized engines not fitted with water-cooled pistons. The pistons are constructed in two parts, with packing rings and babbitted bearing surfaces. They are secured in position on the rods by internal nuts and present plain convex surfaces to the burning gases. Piston rods are of forged steel, with bored water ducts. The packing for both piston rod and tail rod is of metallic ring type.

The engine is started by compressed air pumped into a steel reservoir during a previous run before shutting down. For this purpose a special disengaging gear is provided which isolates the rear cylinder, and on admitting the compressed air allows this cylinder to operate as an air motor until the regular combustion cycle is taken up in the forward cylinder. The rear cylinder may then be thrown into normal action.

Oiling is accomplished by steam engine appliances, such as sight-feed cups, cylinder pumps, and oil rings for crank pins.

The engine is governed by a sensitive flyball governor of the standard design, protected by a circular housing. It operates a vertical piston valve supplying a fuel mixture of constant quality, but in quantities proportionate to the load.

The single-crank engine is at present manufactured in sizes ranging from 250 to 750 horse-power, and the double-crank from 750 to 1,500 horse-power. In the latter, cranks are placed at ninety degrees angularity, giving four impulses per revolution, and a crank effort corresponding to that of a cross-compound double-acting steam engine.



[Copyrighted 1902 by the Westinghouse Machine Company.]

DOUBLE-CRANK, DOUBLE-ACTING INTERNAL COMBUSTION ENGINE.

It is of interest to note that several installations of this type of engine are in progress. The first to be put into operation will be at the works of the Consolidated Industries Company, Batavia, N. Y., employing 250-horse-power, single-crank, double-acting engines, direct-connected to Westinghouse alternating-current generators, operating in parallel upon a general light and power distribution system. A special coke and gas process, known as the Lowe, will be employed, yielding three products—metallurgical coke, coal and water gas, the former to be retailed and the latter used for power purposes.

A second installation at the works of the Atlantic Refining Company, Philadelphia. The engines are double-crank, double-acting, of 500 horse-power each, and are direct-connected to 350-kilowatt

three-phase generators arranged for parallel operation. The engines will operate upon rich oil gas of approximately 1,400 British thermal units per cubic foot, a by-product of the refining process.

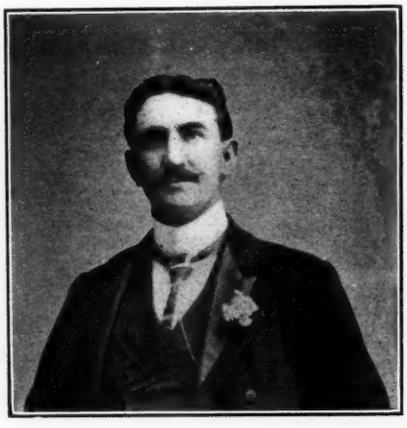
A third interesting installation, at Hillburn, N. Y., will supply the entire Ramapo valley with light and power from a new station now building for the Rockland Electric Company. This plant will also operate upon producer gas, using the Loomis-Pettibone process. The producer plant is located in a separate building and supplies water gas to the Ramapo Iron Works and the Ramapo Foundry Company, for heating and metallurgical purposes, as well as power gas to the generating station. The electrical distributing system will supply power to local industries, as well as lighting for the Ramapo valley, some fourteen miles in extent. The equipment aggregates 1,200 horse-power, employing 350-horse-power single-crank engines of the double-acting type, and a small vertical single-acting engine for driving the exciter. Each main engine is direct-connected to polyphase generators, arranged for parallel operation. This plant will be one of the first alternating-current stations in the country to be operated from gas power.

A further and more recent instance of the confidence placed in the gas power apparatus is that of the Potosina Electric Company, of San Luis Potosina, Mexico, a town of 70,000 inhabitants, situated at an elevation of 6,000 feet above the sea level, about 275 miles northwest of Mexico City. The town was formerly supplied with electric light and power from a double-crank steam-driven plant, which passed into the control of the present company and has been converted into a gas central station.

The plant has been laid out for five main units, an exciter unit, and a compressor, aggregating 1,225 horse-power, and will employ the Loomis-Pettibone process for generating a power gas of approximately 120 British thermal units per cubic foot, calorific value. At the present time but five engines will be installed, comprising three 160-horse-power, single-crank, double-acting machines, direct-connected to polyphase generators, operating in parallel upon the general 2,200-volt, three-phase distributing system; one 50-horse-power two-cylinder vertical single-acting, direct-connected to an exciter; and one 14-horse-power two-cylinder vertical compressor engine. The remaining units, each of 340 horse-power, will be installed later, when required. The producers will be located in a separate gas house and the best grades of Virginia coals will be used for gasification purposes.

A New Insulating Line Material.

This material is made up in several forms, all of which are modifications of a certain peculiar base. "Diamant" is made for moulding up into overhead line material, "Dialite" for single and stranded iron and copper cable insulation, "Diamastic" is an elastic compound for painting ships' bottoms and bridge-work and general iron and structural work, and "Diatrine" is for treating dry core paper for cabling. "Dialite" is made up into such forms that it can be applied either concentrically, longitudinally or spewed on with the regular American seamless machines on standard conductors. It is also made up into all classes of mechanical rubber goods, such as jointers' mats, floor mats, rubber goods and other articles. It is also made up for use as the regulation adhesive tape for line and cable work. "Dialite" gives a high initial ohmic resistance, and has a high puncture resistance. It is non-absorbent and non-hygroscopic. Owing to the process of manufacture, it contains but three per cent of reclaimed rubber, which allows it to be manufactured at a considerably reduced cost. This insulation is stated to be used extensively at the present time by the British Government, for general insulating material on cable and conductor coverings, and is giving satisfaction. A cable which had been installed in a temporary man-way was taken up after two years' service, and showed under mechanical and electrical tests an efficiency practically as high as the initial condition.



J. F. SHERIDAN.

"Diamant" is formed from plastic material, and is pressed up into any suitable shape for overhead line construction, and also for controller parts. This has stood very high electrical tests, and is claimed to be non-hygroscopic, being less absorbent than porcelain. Materials made up under a pressure of 200 pounds will withstand a crushing strain of 2,000 pounds, and have a tensile strength of 6,000 pounds. This material is applicable for the manufacture of telephone receivers and transmitters, and can be bored, tapped and drilled. It is unaffected by temperature changes, and will withstand a heat test of 350 degrees Fahrenheit for three and one-half hours without losing formation or becoming plastic. As a third-rail insulator this material is claimed to have some excellent features. It is resonant when struck, is resilient, and will receive the hardest blows without fracture. Due to its homogeneous quality, it is adapted to high-tension insulation. On a test, a slab one-half inch thick and three inches in diameter gave a resistance of 25,000 megohms, with no puncture, at 40,000 volts, alternating current. After twenty-five hours' immersion in a brine tank, at seventy degrees Fahrenheit, the absorption was one-half of one per cent.

"Diatrine" is a new process for treating dry core paper for cable insulation. By eliminating the oils which have a tendency toward carbonization, the paper is impregnated with a solution which will allow it to be used as an insulator without the danger of it becoming charred or carbonized. With a sheet of paper immersed in a brine tank at seventy degrees Fahrenheit, this had a resistance of 2,000 megohms, and showed no puncture at 5,000 volts, alternating current.

This material is the invention of, and is manufactured by, Mr. J. Francis Sheridan, who is just placing this material on the American market, and tests are invited to substantiate the figures which Mr. Sheridan has supplied. Mr. Sheridan's present headquarters are at 1,717 Chadwick street, South Philadelphia, Pa.

Large Three-Phase Locomotives.

Ganz & Company, of Budapest, have secured the order for three high-pressure three-phase locomotives for the Adriatic Railway. These will be capable, when running at a speed of forty miles per hour, of exercising a normal tractive force of 8,000 pounds, and a maximum tractive force of 12,000 pounds. When running at a speed of twenty miles per hour they will be capable of exercising a normal tractive force of 14,000 pounds, and a maximum tractive force of 22,000 pounds. Each locomotive will have four axles, and will weigh fifty-six tons. The motors will be supplied with three-phase current at 3,000 volts. As passenger locomotives, the motors will be used in cascade connection while starting. As goods train locomotives, they will always run in cascade connection.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

A NEW TELEGRAPH COMPANY—It has been announced that a new telegraph line, to link all of the important cities in the United States, is being promoted by Messrs. Ralph and Max Orthwein, of St. Louis. The company is stated to have secured $500,000 in St. Louis to back the enterprise.

A LARGE COPPER COMPANY FORMED—A combination of copper mining companies, with $500,000,000 capital, has been consolidated under the name of the United Metals Selling Company. The mines under this control are stated to be the Amalgamated Copper, the United Copper, Lake Copper, Calumet and Hecla, United Verde, Green Consolidated, Allouez, British Columbia, Montreal and Boston, Quincy Company, Tamarack, and Tennessee. It has also been reported that the Lake Copper Company, with $155,000,000 capital, will be formed to take over the stocks of the Copper Range Company, and also of the Tri-Mountain properties.

A PLAN TO UTILIZE THE POWER OF THE GREAT LAKES—It is announced that a project to harness the waterways at the head of the lakes, and secure power for a large electric system for Duluth, West Superior and the entire iron range, is the purpose of the formation of the Highlands Canal and Power Company, of West Superior, Wis. The site for the power-house is to be selected very soon, when active work will begin. All the streams and lakes which cover the region will be tapped to create a central reservoir, and the plan contemplates the development of 500,000 horse-power. The promoters are stated to be Captain Alexander McDougall, founder of the Superior Shipyards, and H. C. Cokefair, of New York, who is chief engineer and manager.

HAVANA ELECTRIC RAILWAY—The Havana Electric Railway Company, the corporation which operates about forty miles of trolley line in and about Havana, has recently inaugurated the custom of issuing weekly statements of earnings. For the first week in February, the company's gross receipts were $26,847, in Spanish silver, an increase of $3,913, while for the period from January 1 to February 14, the total gross earnings were $155,000, an increase of $24,130. This amount is equal to $111,311 in American money, taking the rate of exchange at $1.40. The Havana Electric Company operates the city of Havana, with branch lines to Vedado, Cerro, Jesus del Monte, the principal suburbs of the city. The company was incorporated in New Jersey for the purpose of acquiring the Ferro Carril Urbano Omnibus of Havana, which was organized in 1876. The company's franchise runs until 1958. It has common stock amounting to $7,500,000, preferred stock of $5,000,000, bearing six per cent, and $7,500,000 at five per cent bonds. The company is controlled mainly by Canadian interests and the latest reports from Havana are to the effect that its control has been acquired by the Cuba company, whose railroad from Cienfuegos to Santiago was recently completed.

ELECTRIC LIGHTING.

PITTSBURG, PA.—The King Electric Light Company has been granted a franchise to erect poles and string wires along the public highways in St. Ferdinand and Central Townships, for a term of forty-five years.

LYNCHBURG, VA.—Work has been begun on the new power-house for the Lynchburg Water Power Company, to cost $100,000. Power will be supplied for lighting the city, as well as for manufacturing purposes.

NIAGARA FALLS, N. Y.—The Buffalo & Niagara Falls Electric Light and Power Company has elected the following directors for the ensuing year: George Urban, Jr., Wilson S. Bissell, W. C. Warren, Edward Michael, Daniel O'Day, John N. Scatchard, William R. Huntley and Charles R. Huntley.

NIAGARA FALLS, N. Y.—The Toronto & Niagara Power Company, which a short time ago was granted a franchise for power development on the Canadian side of the river, has given notice that it will ask Parliament to permit the capital stock to be raised to $6,000,000 and the bond issue to $5,000,000.

SANGER, ORE.—The Sanger Gold Mines Company, in order to cheapen the cost of opening the mine, is utilizing the exclusive water rights of Eagle River, located within three miles of the property. The water rights are entirely controlled by the company, and will furnish from 1,000 to 2,000 horse-power.

SCHENECTADY, N. Y.—The Hudson River Water Power Company has purchased the Alanson summer property at Conklingville, Saratoga County. The purchase carries with it all the water rights and secures the dam across the Sacandaga River at that point. The purchase price is said to be about $100,000. The power company will construct an immense reservoir, which will flood a vast amount of territory and make a lake about thirty-five miles long.

ELKLAND, PA.—It is rumored that a corporation will be formed by the Potter Gas Company and capitalists from Pittsburg, Bradford and other places, to erect at some point along the line of the Potter Gas Company a mammoth power-house for the supplying of electric power. It is intended to furnish power for running manufacturing plants, etc., at a cost much below the cost of fuel now in use, and it is proposed to make this power available in Lawrenceville, Tioga, Williamsport, Mansfield, Blossburg, Wellsboro, Corning, Elmira and other places. It is said that about fifteen acres of land will be required for the use of the power-house, and that some 200 men will be employed by the corporation.

PERSONAL MENTION.

MR. CALVIN W. RICE has been elected a member of the British Institution of Electrical Engineers.

MR. THOMAS J. FAY has retired from his connection with the Storey Motor and Electric Company, of Harrison, N. J. Mr. Fay was general manager of this company.

MR. STUART S. CRIPPEN, a scientist who has given much study to advanced questions in chemistry and electricity, has been in New York and eastern cities during the past few days.

MR. ISAAC L. RICE has been reelected president of the Consolidated Railway Electric Lighting and Equipment Company, of New York city. Mr. John N. Abbott retires from the company.

MR. CHARLES F. SCOTT, president of the American Institute of Electrical Engineers, and president of the Engineers' Society of Western Pennsylvania, has reprinted and is presenting to a number of friends the response to a toast at the twenty-fifth anniversary of the Engineers' Club, of Philadelphia, held on Saturday, December 6, 1902, entitled "The Engineer of the Twentieth Century."

MR. FRANK B. RAE, consulting engineer, New York city, has arrived at Parral, Mexico, and is looking over the ground at the mines of the Terrenates Consolidated Mining Company, preparatory to a complete installation of electrical equipment. The plant will embrace two 300-horse-power De Laval turbine dynamos of 200 kilowatts each; two 50-horse-power electrical hoists, and two 350-gallon pumps. The power will be transmitted on aluminum conductors one and one-quarter miles to the distributing centre.

DR. A. E. KENNELLY, Harvard University, lectured on "The Laying of the Mexican Government Mexican Gulf Cables" before the New York Electrical Society, February 18, 1903. The story of the cable-making and laying was illustrated by frequent lantern slides. Representatives of all the prominent cable firms in New York city were present, and the collection of cables recently presented to the New York Electrical Society, by the family of the late Cyrus W. Field, was inspected with much interest.

AXEL O. BENDICHSEN, Wm. C. Wall, Jr., Clarence R. Dean, Henry M. Bascom, Albert E. Blackman, Joseph Guttman, Wm. Hogan, Richard J. Riedl, William Mackay, Norman K. Althause, William W. Cully, Alfred R. Tahl, Alfred Bourgeois, Frank Gardner, Alfred J. Thompson, Emile C. Boerner, Jr., T. P. Teale, Jr., M. S. Clawson, G. W. Hallock, Alonzo C. Bell, Alfred W. Eckhoff, W. C. Minier, Bernard B. Neal, Charles V. Walter, A. Th. Moberg and Harry J. Smith, have been elected members of the New York Electrical Society.

ELECTRIC RAILWAYS.

DES MOINES, IOWA—The Des Moines, Mount Ayr & Southern Railway Company has been incorporated at Creston to build an electric line to Mount Ayr from Creston.

NYACK, N. Y.—The state board of railroad commissioners has granted a certificate of necessity to the Rockland Railroad Company, giving it permission to construct a trolley system in the town.

MOUNT HOLLY, N. J.—The board of freeholders has granted permission to the People's Traction Company to construct a trolley line between Mount Holly and Burlington along the public road, a distance of seven miles.

FREDONIA, N. Y.—The village board has granted a franchise for fifty years to the Lake Shore Traction Company. The road is to begin by May 15 next and be completed in one year from the date of granting franchise.

BUFFALO, N. Y.—The Ridge Road Electric Line, which proposes to operate a trolley line through Buffalo, Niagara Falls and Rochester, has been capitalized at $3,500,000, and the work of construction will be begun at once.

NEWCASTLE, PA.—Five new extensions to the traction system here have been planned by the Newcastle Street Railway Company, to cost in the neighborhood of $250,000. The extensions will be built as fast as the necessary franchises can be secured.

CHARITON, IOWA—Citizens of Chariton and Knoxville have formed an electric railroad company with a capital stock of $100,000. The name will be the Chariton, Knoxville & Southern Railway Company. The road is expected to cost about $400,000.

SCRANTON, PA.—The Scranton Lake Speedway Company, with a capital of $100,000, has been incorporated by C. G. Boland, W. P. Boland, Dr. G. E. Hill, Patrick Cusick and James J. Crohan. The company will build an electric road to East Mountain in the vicinity of Mountain Lake, where a pleasure park is to be laid out.

TRENTON, N. Y.—Articles of incorporation of the Augusta & Aiken Railway and Electric Company have been filed. The capital stock is placed at $2,300,000, and the company will build electric railways and electric lighting and gas plants. The incorporators are: K. K. McLaren, H. O. Coughlin and Louis B. Dailey.

BLOOMINGTON, ILL.—The Bloomington & Joliet Railroad was incorporated recently to build interurban roads to connect the principal cities in Illinois. It is licensed to construct a line parallel to the Chicago & Alton Railroad between Bloomington and Joliet, connecting at Joliet with the electric line now running into Chicago.

CINCINNATI, OHIO—The Cincinnati & Columbus Traction Company has filed with the Secretary of State at Columbus its certificate of increase of stock from $10,000 to $2,500,000. Half of this amount is to be five per cent cumulative preferred stock, the balance to be common. It is stated that the entire amount has been subscribed.

LEXINGTON, KY.—The Blue Grass Consolidated Traction Company has given a bond of $1,000 to Woodford County, guaranteeing to begin work on the Frankfort, Versailles & Lexington electric road by April 1. The contract also binds the company to have the whole work completed and cars running in two years from that date, at the outside.

MACON, GA.—The Macon Light and Railway Company has mortgaged its entire property to secure an issue of bonds. The mortgage is for $1,000,000, and the North American Trust Company is named as trustee. The bonds will be fifty-year gold bonds, bearing interest at five per cent. The money realized will be used to improve the company's plant.

BALTIMORE, MD.—At a meeting of the Kent & Cecil Light, Power and Electric Railway Company, held recently at Elkton, it was ordered that a form of contract for the construction of the road from Chesapeake City to Newark, Del., *via* Elkton, be drawn up and reported immediately to the directors. A survey of the proposed line will be made at an early date.

HUDSON, MICH.—The projectors of the new electric railway to run from Toledo to Chicago, paralleling the Lake Shore Railroad, have the right of way for their system laid out. They guarantee to have the road completed as far west as Sturgis before December 20, 1903. The road is in reality an extension of the electric road now in operation between Toledo and Adrian.

HUNTINGTON, IND.—The county commissioners have granted a fifty-year franchise to the Fort Wayne & Southern Traction Company for a line between this city and Marion, by way of Warren. All necessary franchises in Huntington County have now been obtained. The company is essentially the same as the Fort Wayne & Southwestern. Work is to be begun in the spring.

OWENSBORO, KY.—An interurban electric railway, costing $1,000,000, running from Owensboro through sixty miles of the most fertile section of the Green River country, will be started in a few weeks. In six months, the promoters say, the road will be finished. It will extend from this city to Curdsville, on Green River, up the river to Delaware, to Calhoun, and thence to Hartford.

MIDDLETOWN, N. J.—Work has been commenced on the new trolley line between Keyport and Red Bank. The company proposes to run the road on private right of way altogether, and nearly all the rights of way have been secured. After the main line has been constructed spurs will be run to nearby towns not on the direct route. It is believed that the line will be in running order before the first of February.

DES MOINES, IOWA—The Interurban Railway Company contemplates constructing seventy-five or eighty miles of interurban lines next season. Surveys from Colfax to Newton are now in progress, and it is the intention to build south from Colfax to Prairie City, twenty-five miles southeast of Des Moines on the Keokuk line of the Rock Island. A power-house will be erected at Colfax from which power will be furnished to operate cars on the Prairie City line.

TOLEDO, OHIO—An agreement has been reached by the representatives of the Toledo & Western, the Garret, Auburn & Northern Indiana and the Chicago & Indiana Air Line Railway companies for a through electric line between Toledo and Chicago. The Toledo & Western Railway has already been constructed as far as Fayette, near the Indiana line. The project is pushed by a syndicate headed by Judge C. M. Stone, Luther M. Allen and J. E. Seagraves, of Cleveland. The road will pass through Goshen and South Bend.

CINCINNATI, OHIO—The Cincinnati Interterminal Company has filed articles of incorporation, with a capital stock of $10,000, which will be increased at an early date. The company proposes to build connecting railroad lines and switches in the business portion of the city, between the different freight depots, and switch and transfer freight by electric motive power. The company also proposes to build depots for the convenience of the business people of the city, and will go to work on the plans as soon as franchises have been secured.

PORTLAND, IND.—A plan to build a link of interurban road, connecting the Union Traction Company, of Indiana, and the Western Ohio Traction Company, of Ohio, is under way, and if carried to success it means a through route from Indianapolis to Cleveland, Ohio. The plan is to construct a line from Portland to Celina, Ohio, and it is asserted that the road will surely be built provided there is a gift of the right of way. Portland is asked to give eleven miles from here to the state line; Coldwater, Celina and Fort Recovery, Ohio, has each agreed to give five miles. West from this city the other half of the link will be looked after by the Muncie & Portland Traction Company, which has practically the entire right of way secured, and will begin actual construction when the weather permits.

OTTAWA, ILL.—The Ottawa, Marseilles & Morris Railway Company has been incorporated with a capital of $50,000 by the following directors: M. T. Moloney, A. J. Moloney, M. A. Flynn, James F. Moloney and James J. Graham, of Ottawa. The company will build an electric road to connect Ottawa, Marseilles, Seneca and Morris, and it is said work will begin without delay. The route of the new line will parallel the Rock Island, running on a private right of way between the Illinois and Michigan canal and that road. It is the present intention to cross Fox River near the Rock Island bridge. It is announced that the Illinois Traction Company, which is now successfully operating cars to Ladd, will begin work on the extension to Ottawa in the spring, and if the Marseilles line is constructed will enter into transfer arrangements with the new company.

ELECTRICAL SECURITIES.

For the past week there has been little animation in financial conditions. The quotations for the end of the week show slight declines in comparison with a week ago. The steady support accorded a number of raided securities has considerably checked bear operations and professional sentiment inclines toward a continuance of bettering tendencies.

Legislation is still holding the attention of the speculative interests, and the outcome of the Aldrich bill, the Elkins bill and other so-called "anti-trust" measures is eagerly awaited.

The figures given in the last report from the Bureau of Statistics show that the excess of exports over imports for the month of January was $48,900,000; the total exports for the month of January were $134,000,000, as against $129,000,000 for January last year.

New York:	*Closing.*
Brooklyn Rapid Transit	69½
Consolidated Gas	218¾
General Electric	199⅝
Kings County Electric	250
Manhattan Elevated	142¾
Metropolitan Street Railway	139¾
New York & New Jersey Telephone	165
Westinghouse Manufacturing Company	211

Kings County Electric Light and Power was a significant feature of the week. This stock was the subject of an upward movement which carried the quotations from 228 to 250 at which point it was apparently strongly held.

Boston:	*Closing.*
American Telephone and Telegraph	168½
Edison Electric Illuminating	291
Massachusetts Electric	92
New England Telephone	136
Western Telephone & Telegraph preferred	99½

Philadelphia:	*Closing.*
Electric Company of America	9⅛
Electric Storage Battery common	79
Electric Storage Battery preferred	79
Philadelphia Electric	7⅞
Union Traction	47⅜
United Gas Improvement	112¼

Chicago:	*Closing.*
Chicago Edison Light	160
Chicago Telephone	157½
Metropolitan Elevated preferred	84½
National Carbon common	25
National Carbon preferred	98
Union Traction common	9¾
Union Traction preferred	46⅞

TELEPHONE AND TELEGRAPH.

FAIRMOUNT, IND.—The new Citizens' Telephone Company has commenced the work of constructing its plant.

OLEAN, N. Y.—A new telephone company has been organized at Clara, and will connect with the Interocean at Millport.

BLOOMFIELD, IND.—The Home Telephone Company is to be reorganized and reincorporated with a capital stock of $100,000.

ROCKFORD, ILL.—The Bryon Telephone Company has decided to build a line to Rockford to connect with the Home Telephone Company.

ALTOONA, PA.—The United Telephone and Telegraph Company plans an exchange at Bellwood, to serve points along the Pennsylvania and Northwestern division.

MOUNT VERNON, N. Y.—It is said that the New York Telephone Company is to begin at once the construction of a handsome new telephone exchange in Port Chester, to cost not less than $25,000.

WASHINGTON, D. C.—The Chesapeake & Potomac Telephone Company has awarded the contract for its new building, and the work will be completed in nine months. The estimated cost is $200,000.

MOUNT STERLING, KY.—The Eastern Kentucky Telephone Company, of Montgomery County, has filed articles of incorporation at Frankfort, with a capital stock of $25,000. The incorporators are: R. D. Wilson, Henry Watson, Dr. J. A. Shirley.

DETROIT, MICH.—The Union Trust Company, of Detroit, was on February 23 appointed receiver for the Michigan Telephone Company, by Judge Swan, of the Federal Court, Detroit, on application of the Old Colony Trust Company, of Boston.

CHEYENNE, WYO.—The Rocky Mountain Bell Telephone Company has let the contract for the erection of a line from Thermopolis, Wyo., to Billings, Mont., and work will be begun as soon as possible. The line is expected to be in operation by July 1.

BRAZIL, IND.—The Cory Southeastern Telephone Company has been organized to establish service between Saline and Cory. The officers of the company are: President, James French; vice-president, Thomas Mees; secretary, Albert M. Diel; treasurer, Marion McCullough.

BELMONT, N. Y.—At the annual meeting of the Angelica Telephone Company the following officers were elected: President, D. P. Richardson; vice-president, J. T. Brown; treasurer, H. E. Dudley; secretary, C. L. Lathrop. Plans are under way for various improvements in the company's service.

BOSTON, MASS.—The Cumberland Telephone Company, one of the strongest of the American Telephone Company's licensees, now has 338 exchanges in operation, forty-nine of which were built and opened during the year, showing a net gain of 15,893 subscribers, making the total December 31, 1902, 92,425 subscribers.

LA FAYETTE, IND.—Frank F. and Victor Smith, of Franklin, Ind., have become interested in the Franklin Telephone Company, heretofore controlled by F. R. Strickler. The company now owns the city system and lines covering Johnson County and extending into adjoining counties, and this additional capital will give it greatly increased means for extensions.

TALLAHASSEE, FLA.—Letters patent have been issued for the Indian River Telephone Company, of Fort Myers, whose object is to construct a long-distance telephone system from Miami, in Dade County, to Titusville, in Brevard County, a distance of 210 miles. Another telephone company to receive a charter is the Whetstone, of Lake City. A line will be constructed from Lake City to Jasper.

CONNELLSVILLE, PA.—The Maryland, Pennsylvania & West Virginia Telephone Company has been sold to a party of Uniontown and Connellsville business men. The consideration was $40,000. All of the stock is not purchased, but a controlling interest. The company's lines will be extended so that connection can be made with the independent companies in Pittsburg.

UTICA, N. Y.—The annual report of the Central New York Telephone and Telegraph Company shows that the gross earnings of the company increased $33,702.71 over those for the previous year. The company now has 1,545 miles of poles, carrying 5,856 miles of wire. A large amount of money is to be laid out in improvements to the system.

RIDGELY, MD.—The stockholders of the Eastern Shore Telegraph and Telephone Company have elected the following officers: Harry A. Richardson, president; Thomas L. Day, vice-president; Frederick R. Owens, secretary; Dupont Walker, treasurer. Arrangements are being made to place all the important towns on the peninsula in direct communication with Baltimore through use of the cable under Chesapeake Bay.

ALTOONA, PA.—The United Telephone and Telegraph Company, Philadelphia, has planned to spend $250,000 in this vicinity this spring and summer. The improvements consist of a new trunk line between Altoona and Harrisburg, one from Bellefonte to Tyrone and Huntingdon, one from Clearfield to Tyrone, the establishment of an exchange at Bellwood, with a line to Lloydsville, Blansburg, Coalport and Irvona, and a line from Hollidaysburg to Williamsburg. Central exchanges are being placed at Clearfield and Phillipsburg.

INDUSTRIAL ITEMS.

THE NEWTON MACHINE TOOL WORKS, Philadelphia, Pa., has just issued a treatise on a new method of key seating. This describes a new set of machines manufactured by this company, and is supplemented by a number of fine half-tone engravings of different machine tools.

A REPRINT of a paper read by Mr. Charles Day, of the firm of Dodge & Day, Philadelphia, Pa., before the New York Electrical Society on December 17, 1902, on "Requirements of Machine Tool Operation, With Special Reference to the Motor Drive," will be sent by mail, postpaid, on application to Ray D. Lillibridge, 170 Broadway, New York city.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., general sales agent for the Gutmann alternating-current wattmeter, announces a popular demand for these instruments in Europe. Two Gutmann wattmeters recently sent there for comparative tests with other makes of wattmeters, both domestic and foreign, have been awarded a number of honors.

THE GEORGE C. TOWLE MANUFACTURING COMPANY, Lancaster, Pa., is introducing this season a new desk fan. The motor carrying the fan blades and guard revolves on a ball-bearing, the base remaining in a fixed position. This also contains a number of other notable features, including a brake on the base which can be adjusted to secure a desired number of revolutions. This is in addition to the regular speeds of the motor.

THE STERLING-MEAKER COMPANY—At the annual meeting of the Sterling-Meaker Company, held January 15, in New Jersey, directors were elected as follows: L. L. Whitney, O. W. Bird, George Rice, Charles S. Ackley and J. Albert Stowe. The following gentlemen were elected officers: President and treasurer, J. Albert Stowe; vice-president, Charles S. Ackley; secretary, Edward F. Wickwire. The treasurer reported the plant of the company in excellent condition and equal to a large increase in business.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., has recently shipped to the Mutual Automatic Telephone Company, of Albuquerque, New Mexico, a switchboard of one thousand ultimate capacity, the present installation being 400 telephones and switches. The city of Albuquerque has had an automatic telephone service for seven years, the local company having purchased one of the early types of Strowger switchboards. The new equipment was purchased to meet the demand for service beyond the capacity of the switchboard which has been in use.

THE OHIO BRASS COMPANY has decided to substitute alternating current power distribution for the direct-current system at present in use in its shops at Mansfield, Ohio. A recent purchase from the Westinghouse Electric and Manufacturing Company comprises a 180-kilowatt, 7,200-alternation, two-phase alternator, a direct-current exciter, switchboard equipment, and the following induction motors: Two of 40 horse-power, four of 30 horse-power, one of 20 horse-power, one of 15 horse-power, and one of 2 horse-power. This apparatus will provide increased capacity.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., has secured the contracts for and is equipping the following installations: The Okaw Telephone Company, of Sadorus, Ill.; the Northwest Prairie Telephone Company, of Sadorus, Ill.; the White County Union Telephone Company, Carmi, Ill.; the Mason City Telephone Company, Mason City, Ill.; the Citizens' Telephone Company, Grand Rapids, Mich.; the Leeds Telephone Company, Illipolis, Ill.; tne Holland Township Telephone Company, Mode, Ill., and the Guthrie Telephone Company, of Guthrie, Ill.

THE ELECTRIC LAUNCH COMPANY, Bayonne, N. J., reports a very great increase in the popularity of the electric launch. A number of alleged objections which were claimed to be inherent with the storage battery for propelling a launch have been overcome, and the satisfaction is all that could be desired for pleasure purposes. A thirty-one-foot boat has been built for President A. J. Cassatt, of the Pennsylvania Railroad Company, and a number of launches is under construction for tenders and auxiliaries to steam pleasure craft. This departure is one which will be readily appreciated and the batteries in the electric launches can be easily charged while the boat is out of service on the deck of the larger vessel.

EUGENE MUNSELL & COMPANY, 218 Water street, New York city, 117 Lake street, Chicago, and 332 Wellington street, Ottawa, which have long been engaged in mining and importing mica, have recently added to their business the manufacture of mica specialties, such as lamp chimneys, canopies, candle shade protectors, etc. In their 1903 catalogue and price list, just issued, is a line of reflectors for incandescent electric lamps, which is absolutely new. Being made of the best clear mica, they cast no shadow, and it is claimed that they intensify the light fourfold. Some of the forms are made to produce a flower-like effect, with much better results when used with colored lamps for decorative purposes. Application has been made for a patent on these reflectors, and all of Messrs. Munsell & Company's mica specialties will be distinguished by the copyrighted word "Micalite." The catalogue and price list can be obtained by application to any of the above addresses.

NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY, through the office of the general passenger agent, has printed a unique circular which shows the great development which has taken place in the transportation facilities within the past fifty years. A circular time-table of the New York & Harlem Railroad for 1860 is compared with the current time-table of the Harlem division of the New York Central, in effect January, 1903. Nearly forty-three years have passed away since the printing of the first one, and the wonderful growth of American commerce is indicated by the increased number of trains and the increase in speed of these trains. The old circular shows that trains from the White street station stopped to land and receive passengers at the Bowery and Broome street, Houston street, Astor place, Seventeenth and Twenty-sixth streets. Until recalled, these locations have passed entirely out of the minds of New Yorkers as stopping places for a surface steam railroad.

WESTINGHOUSE, CHURCH, KERR & COMPANY, New York city, is continuing to secure a number of orders for the Roney mechanical stoker. This is a fuel and labor saver, and is adaptable for all types of boilers for all classes of power service. A few of the recent orders are as follows: North Jersey Street Railway Company and Jersey City, Hoboken & Paterson Street Railway Company, 12 quadruplex stokers for plant extensions, aggregating 6,250 horse-power; Indianapolis Street Railway, 12 duplex and quadruplex stokers for 4,200-horse-power B. & W. and Zell boilers; Indiana, Lebanon & Frankfort Railway, 12 duplex stokers for 3,000-horse-power plant of Stirling boilers; Utah Light and Power Company, Salt Lake City, 6 duplex stokers for a lighting plant containing 1,250-horse-power Heine boilers; Phœnix Iron Company, 6 quadruplex stokers, for rolling mill plant, fifth order, 2,700-horse-power extension, Heine boilers; Schlitz Brewing Company, Milwaukee, four duplex stokers for plant extension, 600-horse-power horizontal return tubular boilers; Youngstown (Ohio) Consolidated Gas and Electric Company, third order, quadruplex stokers for central lighting, railway and power plant, 1,050-horse-power B. & W. boilers.

THE ALLIS-CHALMERS COMPANY, of Chicago, Ill., will, on May 1, 1903, remove its general offices from the present location in the Home Insurance Building, to the New York Life Building, corner of Monroe and La Salle streets. The Allis-Chalmers Company has for the past two years been expending enormous sums in betterments to its various plants at Milwaukee, Chicago and Scranton. The new offices will provide ample space for the various sales departments and general business offices. During the past two months orders for either engines, mining machinery, rock-crushing machinery, sawmill machinery, or flour-mill machinery, were booked from every state in the Union, besides orders from foreign countries, including England, South Africa, Mexico, Canada, Chili, Central America, Brazil, West Australia, Turkey, Finland, Yukon Territory, Belgium, British Columbia, Bolivia, Hawaiian Islands, Peru, Alaska, China, and the Philippine Islands. The following is a partial list of the engine sales for January, 1903: St. Louis & Suburban Railway Company, St. Louis, Mo., one 30 and 50 x 60, 1890, cross-compound, Reynolds-Corliss engine, two 32 x 60 cylinders; Bethlehem Steel Company, South Bethlehem, Pa., one 30 x 48, 1890, horizontal, Reynolds-Corliss engine; William H. Patterson, Smithville, Mo., one 12 x 30, girder frame, horizontal, Reynolds-Corliss engine, with boiler and heater; Penn-Allen Portland Cement Company, Allentown, Pa., one 20 and 40 x 42, 1890, horizontal, cross-compound, Reynolds-Corliss engine, one 14 x 36, horizontal, Reynolds-Corliss engine, one 12 x 30, horizontal, Reynolds-Corliss engine, one 18 and 36 x 42, cross-compound, Reynolds-Corliss engine; Fraser & Company, Ottawa, Canada, one 30 x 60, 1890, horizontal, Reynolds-Corliss engine.